SIXTH MEASUREMENT AND MONITORING LITERATURE UPDATE

Acoustic Gas Detection
Journal of Offshore Technology, Vol 8 No 6, p 22-23, Nov 2000

This paper describes a new detection system that uses sound rather than optical or chemical properties to determine the presence of escaping gas. The system can be operated in extreme weather conditions and is insensitive to wind, sun, fog, rain or snow.

Adaptation of Existing Electrochemical Instruments for the Real-Time Personal Monitoring of Hydrogen Fluoride in the Presence of Sulfur Dioxide
Carter, S.; N. Seixas; M. Morgan, Univ. of Washington, Seattle.
American Industrial Hygiene Conference & Exposition, 2-7 June 2001, New Orleans, Louisiana

While electrochemical sensors are readily available for many inorganic gases including sulfur dioxide, only a few exist for hydrogen fluoride. HF sensors generally have a cross-sensitivity to sulfur dioxide, making it difficult to monitor HF in an environment that also contains SO_2, as occurs in aluminum smelter potrooms. The researchers assessed the simultaneous use of two electrochemical instruments: one with a SO_2 sensor that does not respond to HF and the second with a hydrogen fluoride sensor that responds to both HF and SO_2 in a 1:1 ratio, termed "total acid gas." The instruments were modified slightly to operate in series with active sampling. The SO_2 instrument demonstrated a response of 92-111%, while the total acid gas instrument ranged from 80-120% . The response and recovery times for the SO_2-only instrument were acceptable (6 and 15 seconds), but the "total acid gas" instrument exhibited both slow response and slow recovery. This approach for the real-time measurement of hydrogen fluoride is feasible, but is limited by differences in sensor response/recovery times and the need to use multiple instruments for analysis and data logging.

Adaptive Remote-Sensing Techniques Implementing Swarms of Mobile Agents
Cameron, S.M.; G.M. Loubriel; R.D. Robinett III; K.M. Stantz; M.W. Trahan; J.S. Wagner, Sandia National Labs.
SPIE 13th Annual International Symposium on Aerospace/Defense Sensing, Simulation, and Controls, 5-9 April 1999, Orlando, FL.
Paper No: SAND99-0770C, 18 pp, Apr 1999

This paper focuses on work at Sandia National Laboratories toward engineering a physics-based swarm of mobile vehicles for distributed sensing applications. The goal is to coordinate a sensor array that optimizes sensor coverage and multivariate signal analysis by implementing artificial intelligence and evolutionary computational techniques. These intelligent control systems integrate both globally operating decision-making systems and locally cooperative information-sharing modes using genetically-trained neural networks. Once trained, neural networks have the ability to enhance real-time operational responses to dynamical environments, such as obstacle avoidance, responding to prevailing wind patterns, and overcoming other natural obscurants or interferences (jammers). The swarm realizes a collective set of sensor neurons with simple properties incorporating interactions based on basic community rules (potential fields) and complex interconnecting functions based on various neural network architectures, and therefore the swarm is capable of redundant heterogeneous measurements, which furnishes an additional degree of robustness and fault tolerance not afforded by conventional systems, while accomplishing such cognitive tasks as generalization, error correction,

pattern recognition, and sensor fission. The robotic platforms could be equipped with specialized sensor devices including transmit/receive dipole antennas, chemical or biological sniffers coupled with recognition analysis tools, communication modulators, and laser diodes.
http://www.osti.gov/bridge/product.biblio.jsp?osti_id=5682

Advanced Data Analysis Methods for Analyte Recognition from Optical Sensor Arrays
Priebe, Carey E., Johns Hopkins Univ., Baltimore, MD. Dept. of Mathematical Sciences.
DTIC Order No: ADA395040. 7 pp, Jun 2001

This brief report lists the papers that have been produced during a project to develop advanced statistical pattern recognition methodologies for the Tufts University artificial nose and other sensors of interest -- notably, hyperspectral imagers. This effort had significant positive impact on the Tufts University artificial nose. In particular, the following paper is among the most important papers ever published on statistical pattern recognition for artificial olfactory sensor systems: C.E. Priebe, 'Olfactory Classification via Interpoint Distance Analysis,' IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol No 4, p 404-413, April 2001. This effort produced workable initial versions of a methodology for jointly optimizing classification with sensing and processing, in terms of adaptive dimensionality reduction. This latter concept is relevant to a wide variety of adaptive sensors, and is an area for future research.
The full text of the bibliography is available in PDF through the DTIC search engine at http://stinet.dtic.mil/str/tr_fields.html

Advanced UXO Detection/Discrimination Technology Demonstration: U.S. Army Jefferson Proving Ground, Madison, Indiana
Cespedes, E.R., U.S. Army Engineer Research and Development Center, Vicksburg, MS.
Report No: ERDC/EL TR-01-20, 96 pp, 2001

Unexploded ordinance (UXO) detection technology demonstrations were conducted from June to November 2000 at three 1-hectare areas within the U.S. Army Jefferson Proving Ground in Madison, Indiana. The demonstrations were designed to assess the capabilities of state-of-the-art technologies to detect, discriminate, and identify UXO in areas containing natural (magnetic rocks/soils) and man-made (munitions fragments) clutter. Cost and production rates for each of the systems were documented and compared with standard “mag and flag” operations. This report documents the metrics developed for evaluating field performance, summarizes the performance of each of the systems, and identifies areas where improvements are needed. The results of these demonstrations are intended to aid the Government in selecting effective and efficient UXO detection and discrimination systems for difficult magnetic clutter sites, such as those encountered at Kaho’olawe, Hawaii.
http://www.wes.army.mil/el/elpubs/genrep.html

Advances in Time-of-Flight Mass Spectrometry for Atomic and Molecular Analysis
Guzowski, John Paul, Jr., Ph.D. dissertation, Indiana University.
University Microfilm, UMI Pub No AAT 9980989. ISBN: 0-599-87220-9. 309 pp, 2000

Time-of-flight mass spectrometry (TOFMS) has emerged as a powerful tool for the analysis of biological, organic, and inorganic samples. A trade-off between precision and sensitivity is not required when TOFMS is employed because all ions in the beam are sampled at the same instant in time, thus a complete mass spectrum is generated for each event and all m/z's are detected essentially simultaneously. Moreover, the TOF is ideally suited for interfacing with sources that produce transient signals since this spectrometer is designed to sample discrete ion packets. This research has developed a novel ionization source—the gas sampling glow discharge (GSGD)—that has been interfaced to an orthogonal extraction TOFMS. The helium GSGD is a versatile device that can generate both atomic and molecular fragment patterns for a sample vapor. In most cases, the molecular fragmentation patterns strongly resemble conventional 70 eV electron impact mass spectra. More importantly however, it is possible to rapidly (>100 Hz) switch the source between hard and soft ionization modes; information from each spectrum can be collected sequentially with a boxcar integrator. A variety of sample introduction systems have been coupled with the GSGD, including a flow-cell, exponential dilutor, capillary gas chromatograph, and electrothermal vaporizer. The advantages of producing both types of mass spectra in a single analytical sequence are immediately apparent, and this capability can be applied profitably to chemical speciation studies. A hexapole collision cell for the inductively coupled plasma TOFMS has been developed also and used to improve instrumental figures of merit. The sampled ion beam possesses a velocity component that lies perpendicular to the TOF axis, which leads to a mass-dependent steering plate bias and is a disadvantage particular to the right-angle geometry. The sampled ions are collisionally dampened and focused within the hexapole; the resulting beam is nearly mono-energetic and the steering plate bias removed. Furthermore, the kinetic energy distribution of the argon ion beam is reduced through collisions with buffer gas and mass resolution is improved. The collision cell can be used to effect selective and specific ion-molecule reactions that might serve to mitigate spectroscopic interferents. In the present study, charge exchange with hydrogen buffer gas lowers the quantity of argon ions transferred into the TOF extraction zone which in turn reduces chemical noise, eliminates the need for a deflection pulse, and removes calcium and iron isobars.

Air Sampler Zeros in on Atmospheric Pollutants
Preuss, Paul, Berkeley Lab.
ScienceBEAT, 1 Sep 1999

Lara Gundel of the Environmental Energy Technologies Division (EETD) at Berkeley Lab and her colleagues used a "denuder" -- a device that traps gas and allows particles to be collected separately -- in a tobacco study. Denuders are not commonly used with organic chemicals but Gundel used sticky resin beads whose pores were the right size to trap molecules of organic gases, small enough to adhere through friction alone to the sand-blasted inner surface of a glass tube. After an air sample is sucked through the denuder, the particle filter is removed and the gas trapped on the resin beads is analyzed. Gundel had a working model of a denuder, which she later named the Integrated Organic Vapor/Particle Sampler, or IOVPS, built for the tobacco-smoke study. The researchers tried it in a room-sized chamber that held smoke from a single cigarette. In about 30 seconds, they knew it was going to work. Gundel refined the IOVPS as part of a successful Cooperative Research and Development Agreement with URG Corporation in North Carolina, increasing the denuding surface and designing new features for collecting vapor subsequently released from trapped particles. A few years ago a Canadian researcher, Douglas Lane of the Atmospheric Environment Service, collaborated with Gundel to modify the IOVPS for much higher flow rates and continuous operation -- up to 48 hours at time -- which would allow it to be used for testing the atmosphere outdoors. The resulting Integrated Organic Gas and Particle Sampler (IOGAPS) comes in several sizes, the largest of which uses two denuder tubes with about 30 times the coated area of a single-channel IOVPS. Groups around the country have employed this sampling technology in studies of semivolatile organic compounds. Among these have been investigations of the atmospheric behavior of dioxins and the contribution of diesel, other vehicle exhausts, and wood smoke to smog formation -- all under different weather conditions, in different parts of the country, and at different times of the day or night. A patent for the IOVPS technology was awarded in 1998, and Gundel and her associates are actively seeking licensing partners through the Lab's Technology Transfer Department.

Airborne Lidar and Airborne Hyperspectral Imagery: a Fusion of Two Proven Sensors for Improved Hydrographic Surveying
Smith, R.A.; J.L. Irish; M.Q. Smith.
Proceedings, Canadian Hydrographic Conference 2000, Montreal, Canada.

Airborne lidar has become a fully operational tool for hydrographic surveying in recent years. Currently there are four airborne laser bathymetry (ALB) systems operating worldwide. One system, the U.S. Army Corps of Engineers Scanning Hydrographic Operational Airborne Lidar Survey (SHOALS), simultaneously measures water depth and adjacent surface topography. Airborne hyperspectral imagery from the Compact Airborne Spectrographic Imager (CASI) has been proven to be a valuable tool for coastal measurements and analysis. CASI's spectral resolution of 288 bands for each spatial pixel allows for the extraction of a vast amount of information such as water clarity, water temperature, bottom type, bathymetry, as well as water quality (chlorophyll, dissolved organic carbon, and suspended minerals), soil types, and plant species. For ALB to achieve a comprehensive hydrographic capability, additional sensors would have to be integrated. Combining SHOALS and CASI would be a substantial step in accomplishing a full hydrographic survey capability for ALB. Surveys using this combination of sensors will provide valuable information for different agencies. The U.S. Army Corps of Engineers needs information that will aid in sediment transport monitoring and regional sediment management. The Naval Oceanographic Office (NAVOCEANO) uses the ALB system to collect hydrographic information about the littoral zone for the warfighter. By adding the hyperspectral capability, NAVOCEANO may be able to enhance its ability to quickly provide a more complete environmental picture.
Available at http://shoals.sam.usace.army.mil/Pages/publications.htm

The Analysis of Mercury and its Species for Environmental Applications
Boylan, Helen Marie, Ph.D. dissertation, Duquesne University.
University Microfilm, UMI Pub No AAT 3016679. ISBN 0-493-27792-7. 213 pp, 2001

This study has made significant contributions in the field of analytical/environmental chemistry of mercury. The fundamentals of an instrumental system based on thermal decomposition, amalgamation, and atomic absorption spectrometry have been explored in detail. EPA Method 7473 has been developed and validated based on this instrumental system. Method 7473 has been rigorously tested in field environments in conjunction with mercury remediation of soil at natural gas utility sites, and is one of the first EPA methods officially recognized for the quantitative field and laboratory analysis of mercury. Two complementary speciation techniques have been investigated during this study. The research provides some of the framework for the Speciated Isotope Dilution Mass Spectrometry (SIDMS) analysis of mercury species, which is a definite technique for mercury speciation. Additional speciation techniques have been tested in conjunction with the development of draft EPA Method 3200 for the selective extraction of operationally-defined mercury species. The coal-powered electric utility, which has been determined to be the largest source of man-made mercury emissions, has also benefitted from this research. Analytical results for mercury in coal and coal by-products have been significantly improved. In addition, a method for estimating yearly mercury emissions and the associated uncertainty based on mass balance calculations has been developed and applied to real-world data. Several aspects of analytical chemistry of mercury have been investigated throughout the course of this research. A rapid and portable method for the analysis of total mercury has been validated. Mercury speciation techniques have been refined, and the analysis of coal by-products has been used to predict mercury emissions. The fundamentals associated with these methodologies have been worked out, and these techniques have been used to help tackle real-world environmental problems.

Analytical Methods Comparison for Dissolved Arsenic Speciation
Bednar, A.J. (Colorado School of Mines, Golden, CO), J.F. Ranville, T.R. Wildeman; J.R. Garbarino (U.S. Geological Survey, Denver, CO), P.J. Lamothe, K.S. Smith; B.R. McCleskey (U.S. Geological Survey, Boulder, CO), J.W. Ball, D.K. Nordstrom.
USGS Workshop on Arsenic in the Environment, 21-22 February 2001, Denver, CO

The work in this area originally focused on a need to determine the most reliable and convenient method of arsenic speciation in groundwaters and acid mine drainage (AMD). Inorganic species, namely arsenite [As(III)] and arsenate [As(V)], usually predominate in such environments. However, organoarsenicals can often also be significant in surface waters, especially when they have been affected by human activities. Several forms of organic arsenicals are used as animal feed supplements and as cotton herbicides. Little is known of the chemistry and ultimate fate of these compounds once distributed in the environment. The researchers currently are investigating the chemistry, particularly photooxidation, of these compounds in natural systems to further the implementation of passive treatment of waters contaminated by different forms of As. Several methods are available for arsenic speciation, some of which are designed specifically for inorganic species, while others can determine both organic and inorganic forms. Existing techniques were compared to determine their strengths and weaknesses. Modifications of some existing methods provided improvements. Published methods were often incompatible with the researchers' matrices of interest, which also necessitated modifications of existing methods.
http://wwwbrr.cr.usgs.gov/projects/GWC_chemtherm/Arsenic/finalabstracts.htm

Application and Field Validation of a Continuous Nonmethane Organic Carbon Analyzer
Mitra, Somenath (New Jersey Inst. of Technology, Newark), Chaohua Feng, Naihong Zhu; Gary McAllister (U.S. EPA, Research Triangle Park, NC).
Journal of the Air & Waste Management Association, Vol 51 No 6, Jun 2001

An online instrument for continuous NMOC monitoring, referred to as C-NMOC, uses a microsorbent trap in combination with a gas-sampling valve as the sampling interface. A conventional oxidation/reduction NMOC detector handles quantitation. The C-NMOC can handle high concentrations of background gases commonly found in stack emissions and has detection limits in the ppb levels. This paper reports the results of field validation and testing of a C-NMOC analyzer at a coatings facility in the eastern United States, where the instrument demonstrated good accuracy, high precision, and long-term stability.

Application of Laser-Induced Breakdown Spectroscopy to In Situ Analysis of Liquid Samples
Samek, Ota (Univ. of Wales, Swansea); D.C. Beddows; J. Kaiser (Technical Univ. of Brno); S.V. Kukhlevsky (Janus Pannonius Univ.); M. Liska (Technical Univ. of Brno); H.H. Telle (Univ. of Wales, Swansea); A.J. Whitehouse (Applied Photonics Ltd.).
Optical Engineering, Vol 39 No 8, p 2248-2262, Aug 2000

The authors describe a realization of laser-induced breakdown spectroscopy for real-time, in situ and remote analysis of trace amounts in liquid samples that is potentially applicable to the analysis of pollutants in water in harsh or difficult-to-reach environments. Most of the measurements were conducted using a fiber assembly capable of both delivering the laser light and collecting the light emitted from the micro plasma up to about 30 min from the target area. A telescopic arrangement for line-of-sight measurements was employed as an alternative method, with a range of 3 to 5 m. Numerous elements, including a range of toxic heavy metals (Al, Cr, Cu, Pb, Tc, U, and others), have been measured over a wide range of concentrations. Limits of detection usually were in the range of a few parts per million; for several elements even lower concentrations could be measured.

Application of Reporter Genes to Assess Bioremediation Potential
Glover, L. Anne; Ken Killham; Graeme Paton; Roger Hollis; Sofia Sousa, Univ. of Aberdeen, Aberdeen, Scotland.
MAREP: Marker/Reporter Genes in Microbial Ecology, Second International Conference, 4-7 December 1999, Stockholm, Sweden. Book of Abstracts, p 6, 1999

Conventional toxicity assessment in a bioremediation project involves analytical techniques such as spectrometry, chromatography (HPLC and GC), GC-mass spectrometry, and atomic absorption techniques for the determination of heavy metals. These techniques are powerful and sensitive to ppm and ppb levels. However, the ability to detect a compound does not provide information regarding the biological effects of that compound, its persistence in the environment, or information that can be employed in the design of a remediation strategy. *lux* and *luc*-marked microbial biosensors have been found to be rapid and sensitive indicators of toxicity of a wide range of organic and inorganic pollutants. This paper reports the use of bioluminescent whole-cell biosensors, based on reporter gene technology, to assess the toxicity of soils and ground water. This approach, coupled with a regime of sample manipulation, allows the determination of the nature of the toxicity, as well as providing information on which to base a remediation strategy.
Book of abstracts available at http://www.sh.se/marep/congr2test.html

Applications of Laser Multiphoton Ionization to Fast Analysis of Environmental Samples
Schechter, I. (Dept. of Chemistry, Technion Israel Inst. of Technology, Haifa, Israel); V.V. Gridin; V. Bulatov; S. Hasson; T. Inoue; M. Fisher; C. Sluszny; I. Litani-Barzilai; A. Korol; M. Kadosh.
Laser Applications to Chemical and Environmental Analysis, 11-13 February 2000, Santa Fe, New Mexico. Technical Digest, Postconference Edition.
Optical Society of America, Washington, DC. TOPS Vol 36, p 173-175, 2000

Laser multiphoton ionization was applied for direct environmental analysis under ambient conditions. The fast-conductance detection system was used in most applications, where the laser-induced photocharges are registered as a function of time. The environmental applications studied include contaminated soils, airborne contaminants, and polycyclic aromatic hydrocarbons (PAHs) in liquids. A modification of this technique involving monitoring of the ion-induced mirror charges was applied to sensitive air analyses. The MPI techniques have been successfully introduced for routine environmental analysis of organic contaminants such as PAHs.

Arsenic Speciation Test Kit
American Academy of Environmental Engineers, Annapolis, MD. Excellence in Environmental Engineering, 2001 Winning Projects. AAEE web site.

Among the American Academy of Environmental Engineers Excellence in Environmental Engineering awards presented in 2001, WERC (a consortium for environmental education and technology development) received the Grand Prize for University Research for the development of an arsenic speciation test kit. This University Research Project was conducted at the New Mexico Institute of Mining and Technology (NMIMT), in Socorro, New Mexico. NMIMT is a partner of WERC. The research was principally the work of Ph.D. candidate Gregory Miller, who was faced with the problem of measuring arsenic species in a Mexican surface water system for his dissertation research. He created a portable kit that contains all of the equipment necessary to collect field samples of water and separate the four dominant aqueous arsenic species. This process can be done in the field in a 15-30 minute procedure with the kit ready to be mailed to a commercial laboratory for analysis. The kit contains all of the documentation necessary for a legally defensible analysis. People who have little or no technical training can perform the sampling process. The kit is composed of recyclable components, and none of the chemicals used in the kit is hazardous. A patent application has been filed, and the kit is undergoing testing by the Environmental Protection Agency to validate its accuracy.
For more information, visit http://www.enviro-engrs.org/newlook/newtechnology.htm

Assessment of Electrokinetic Removal of Heavy Metals from Soils by Sequential Extraction Analysis
Reddy, K.R.; C.Y. Xu; S. Chinthamreddy, Dept. of Civil Materials Engineering, Univ. of Illinois, Chicago.
Journal of Hazardous Materials, Vol 84 No 2-3, p 279-296, 29 Jun 2001

This paper investigates the speciation and extent of migration of heavy metals in soils during electrokinetic remediation. Laboratory electrokinetic experiments were conducted using two diverse soils, kaolin and glacial till, contaminated with chromium as either Cr(III) or Cr(VI). Initial total chromium concentrations were maintained at 1000mg/kg. Sequential extractions were performed on the contaminated soils before and after electrokinetic treatment to provide an understanding of the distribution of the contaminants in the soils. The initial speciation of contaminants was found to depend on the soil composition as well as the type and amounts of different contaminants present.

Automated Identification of Infrared Spectra of Hazardous Clouds by Passive FTIR Remote Sensing
Zhang, Jun (Yantai Univ.); Yanjun Gong.
Multispectral and Hyperspectral Image Acquisition and Processing.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 4548, p 356-362, 2001

A passive infrared system monitoring is used to detect specific hazardous clouds in the atmosphere and sound an alarm. This paper describes the design and operation of the Fourier transform infrared spectrometer system..

Automatically Monitored Underground Storage Tank (AMUST) Dual Containment and Leak Detection System
Tinker Air Force Base Environmental Management Directorate web page

Tinker AFB is introducing an Automatically Monitored Underground Storage Tank (AMUST) system that features a flexible liner placed into an existing single wall steel or fiberglass tank to create a double-walled tank. A controller housed in the system creates a vacuum in the interstitial space between the tank wall and the liner, and a microprocessor monitors the vacuum continuously to identify any leaks in either the liner or outer tank. The controller can detect even microscopic holes too small for product or water to leak through. An on-site alarm sounds when a leak is detected, drawing immediate attention from personnel and preventing a reportable release from occurring. This technology provides a cost-effective, less intrusive method of upgrading existing tanks to meet UST regulations for leak detection and secondary containment. The retrofits can be installed while existing tanks and pavements remain in place. No tank removal is required. Because the liner is constantly monitored for leaks, regulatory requirements for inspection would probably not be required. This technology may also be transferred throughout private industry and military installations. The cost for this system is expected to be about one-half the cost of installing a double-walled tank with leak detection. The cost of a double-walled tank averages about $28,000, depending on the size, not including the cost of excavation. The average cost to upgrade an existing tank with leak detection and spill overfill prevention is estimated between $10,000 to $15,000. The cost for installing the AMUST system is estimated at $6,000 to $10,000.

Borehole-Radar Methods: Tools for Characterization of Fractured Rock
Singha, K.; K. Kimball; J.W. Lane Jr.
U.S. Geological Survey Fact Sheet FS-054-00, 4 pp, May 2000

Borehole-radar reflection methods provide information on the location, orientation, and lateral extent of fracture zones that intersect the borehole, and can identify fractures in the rock surrounding the borehole that are not penetrated by drilling. Cross-hole radar logging provides cross-sectional maps of the electromagnetic properties of bedrock between boreholes that can identify fracture zones and lithologic changes and can also be used to monitor tracer tests. Borehole-radar logs can be integrated with results of surface-geophysical surveys and other borehole-geophysical logs, such as acoustic or optical televiewer and flowmeter, to distinguish transmissive fractures from lithologic variations or closed fractures. Integrated interpretation procedures provide results that can be used to develop conceptual and numerical models, design monitoring and sampling programs, and monitor implementation of contamination remediation measures, such as blast-fracturing.
http://water.usgs.gov/ogw/bgas/publications/FS-054-00/

Cation-Exchange Separation of Interfering Metals from Acid Mine Waters for Accurate Determination of Total Arsenic and Arsenic(III) by Hydride Generation-Atomic Absorption Spectrometry
McCleskey, R.B.; D.K. Nordstrom; J.W. Ball, U.S. Geological Survey, Boulder, CO.
USGS Workshop on Arsenic in the Environment, 21-22 February 2001, Denver, CO

Accurate and precise determination of inorganic As (III/V) redox species is important in the interpretation of its toxicity and mobility in acid mine waters. Several analytical methods use arsine generation to separate arsenic species but high metal concentrations can suppress arsine production. The potential inhibition of arsine formation by eleven metal species, including Cu, Fe(III), Fe(II), Al, Cd, Mn, Zn, Co, Ni, Cr(III), and Cr(VI), ranging in concentration from 0-1000 mg/L, was investigated with a flow injection analysis system (FIAS) and detection by atomic absorption spectrometry. Interfering metal cation species can be removed with cation exchange resin while maintaining existing As(III)/As(T) ratios (As(T)=As(III+V)). The pre-analysis separation of Fe(III) using cation exchange resin for the determination of As redox species using ion chromatography in iron sulfate-sulfuric acid media has been successfully performed in the past. Oxidation of As(III) by Fe(III) was also investigated.

Characterization and Interpretation of Spectra From a Dual-Beam FT-IR interferometer Using a Heated Gas Cell
Shaffer, R.E.; R.J. Combs, Edgewood Chemical Biological Center. Aberdeen Proving Ground, MD.
Report Number: ECBC-TR-084, DTIC Order No: ADA378929. 26 pp, May 2000

The commercially available model MR254/AB FTIR spectrometer is based on a dual-beam interferometer design. One arm of the dual-beam interferometer uses an internally controlled blackbody source for passive standoff airborne applications. This configuration with an internal blackbody produces a variety of output spectra that do not necessarily follow the output spectral conventions of a single-beam FTIR spectrometer. The differences between a dual-beam and single-beam instrument are documented with eight examples using the radiance equation that models the dual-port MR254/AB spectrometer spectral response in terms of internal blackbody, gas cell, and background blackbody spectroradiometric temperatures.
The full text of this report is available in PDF through the DTIC search engine at
http://stinet.dtic.mil/str/tr_fields.html

Characterization of the Earth's Surface and Atmosphere From Multispectral and Hyperspectral Thermal Imagery
Hernandez-Baquero, Eric D., Doctoral dissertation, Air Force Inst. of Tech., Wright-Patterson, AFB, OH.
NTIS: ADA379997. 270 pp, Jul 2000

The goal of this research was to develop a new approach to solve the inverse problem of thermal remote sensing of the Earth. The problem falls under a large class of inverse problems that are ill-conditioned because there are many more unknowns than observations. The approach is based on a multivariate analysis technique known as Canonical Correlation Analysis (CCA). By collecting two ensembles of observations, it is possible to find the latent dimensionality where the data are maximally correlated. This produces a reduced and orthogonal space where the problem is not ill-conditioned. In this research, CCA was used to extract atmospheric physical parameters such as temperature and water vapor profiles from multispectral and hyperspectral thermal imagery. CCA was also used to infer atmospheric optical properties such as spectral transmission, up-welled radiance, and down-welled radiance. These properties were used to compensate images for atmospheric effects and retrieve surface temperature and emissivity. Results obtained from MODTRAN simulations, the MODerate resolution Imaging Spectrometer (MODIS) Airborne Sensor (MAS), and the MODIS and Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER/ MASTER) airborne sensor show that it is feasible to retrieve land surface temperature and emissivity with 1.0 degrees K and 0.01 accuracies, respectively.
The full text of this report is available in PDF through the DTIC search engine at
http://stinet.dtic.mil/str/tr_fields.html

Classification of Infrared Spectra of Organophosphorus Compounds with Artificial Neural Networks
Mayfield, Howard T. (Air Force Research Lab.); DeLyle Eastwood (Air Force Inst. of Technology); Larry W. Burggraf.
Pattern Recognition, Chemometrics, and Imaging for Optical Environmental Monitoring.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 3854, p 56-64, 1999

Artificial neural networks can be used to classify IR spectra of organophosphorus pesticides and chemically related compounds. The researchers pretreated spectral data obtained from commercial libraries, government agencies, and government contractors to reduce artifacts arising from the variety of collection sources and then divided them into spectral 'bins' of equal frequency width. The spectral data vectors served as inputs to neural networks examined as spectral classifiers.

Comparison of Spectral and Interferogram Processing Methods Using Simulated Passive Fourier Transform Infrared Remote Sensing Data
Shaffer, Ronald E.; Roger J. Combs, Naval Research Lab., Chemistry Division, Washington, DC, or current address: General Electric, Corporate R&D, Schenectady, NY.
Applied Spectroscopy, Vol 55 No 10, Oct 2001

The researchers generated synthetic single-beam spectra and interferograms for one-, two-, and four-component mixtures of organic vapors (ethanol, methanol, acetone, and methyl ethyl ketone) in two passive FTIR remote sensing scenarios. Discrimination of target analytes in complex mixtures requires a large temperature differential between the infrared background source and analyte cloud. Quantitative analysis was found to be possible only when the temperature of the analyte cloud was stable or known and differed significantly from the background temperature. Net analyte signal methods demonstrated that interferogram and spectral processing methods supply identical information for multivariate pattern recognition and calibration.

Comparison of SPME/Transmission IR and SPME/ATR-IR Spectroscopic Methods in Detection of Chloroanilines in Aqueous Solutions
Yang, Jyisy; Fang-Pei Tsai, Chung-Yuan Christian Univ., Chung-Li, Taiwan, China.
Applied Spectroscopy, Vol 55 No 7, Jul 2001

Among the existing infrared (IR) methods, attenuated total reflection (ATR) combined with the solid phase micro-extraction (SPME) principle is used most frequently for the detection of organic compounds in aqueous solutions. The researchers developed an SPME/transmission absorption infrared (TA-IR) method and compared its performance with that of the ATR-IR method. The SPME/TA-IR method provided better linearity (0 to 200 ppm concentration range) and sensitivity than SPME/ATR-IR in detection of chloroanilines. The high-energy throughput in the SPME/TA-IR method largely reduced the noise level in the spectra, allowing SPME/TA-IR to provide slightly lower detection limits than SPME/ATR-IR.

Computed-Tomography Imaging SpectroPolarimeter (CTISP): A Passive Optical Sensor
Bennett, Hollis H. (Jay), Jr.; Ricky A. Goodson; John O. Curtis, U.S. Army Engineer Research and Development Center, Environmental Lab., In-House Lab., Independent Research Program, Vicksburg, MS.
Report No: ERDC/EL TR-01-32, Vol 1: 112 pp, Vol 2: 218 pp, Sep 2001

An optical imaging system is described that simultaneously measures the wavelength dependence and polarization state dependence of light reflected from any surface. Potential applications of this technology include identifying man-made objects from natural backgrounds, land cover classification, and a myriad of agricultural problems such as ground moisture measurements, estimation of crop health, etc. Polarization effects are quantified through the use of Stokes parameters. Both spatial and wavelength-dependent data are collected simultaneously through the use of a phase-only computer-generated hologram as a diffraction grating. Image reconstruction is achieved through an

inversion procedure called computed tomography. Appendix A of the report provides information on controller hardware and software configuration, and Appendix B (in Volume 2) contains the code listings.
http://www.wes.army.mil/el/elpubs/genrep.html

A Conducting Polymer-Based Electronic Nose for Landmine Detection
Lewis, Nathan S. (California Inst. of Tech., Pasadena); R.M. Goodman; R.H. Grubbs.
NTIS: ADA395352, 163 pp, 10 Oct 2001

This program was part of DARPA's 'Dog Nose' initiative to develop landmine detection technology based upon the chemical signature of the mine explosive charge. The focus of this DARPA-sponsored project was to exploit the exciting breakthrough technology developed recently at Caltech that forms the basis for a low power, simple, manufacturable 'electronic nose'. This nose-on- a-chip involves chemically sensitive resistors, whose signals reveal the identification and concentration of vapors in a fashion analogous to that of the mammalian olfactory system. This technology, based on the characteristic chemical signature of mines, has been developed into a landmine detection system that operates in real time through a VLSI-compatible Si process.

Construction of a Hg-Reducing Reporter Strain for Biosafety Experiments in Flow Microcosms
Pauling, Bjorg V.; Irene Wagner-Dobler, GBF-National Research Center for Biotechnology, Braunschweig, Germany.
MAREP: Marker/Reporter Genes in Microbial Ecology, Second International Conference, 4-7 December 1999, Stockholm, Sweden. Book of Abstracts, [poster presentation] p 34, 1999

In a project to construct a mercury-reporter strain, *Pseudomonas putida* KT2442::mer73 had the merTPAB genes from *Serratia marcescens* stably integrated in its chromosome, where they are expressed constitutively under the control of a host promoter. The objective of this work is to construct a safety strain that has, in addition to the Hg-resistance genes, gfp inserted in its chromosome. In order to be able to detect possible gene transfer the researchers decided to insert the gfp immediately downstream the mer-operon. For the construction of the safety strain, the chromosomal DNA flanking the mer-genes has been sequenced, and a PCR-product containing chromosomal DNA and mer has been cloned into pUC19oriT. Three different unstable variants of GFP were then inserted downstream the mer genes. Via homologous recombination the chr-mer-gfp-chr fragment will integrate into the chromosome at the location of the mer-operon in *Ps. putida* KT2442::mer73. The plasmid will be brought into *Ps. putida* KT2440 by triparental mating and those transconjugants will be selected for that are mercury resistant and show green fluorescence. This strain will eventually be inoculated into flow microcosms with sediment layers simulating a river for monitoring the fate of the GEM and to detect possible gene transfer.
Book of abstracts available at http://www.sh.se/marep/congr2test.html

Continuous Emissions Monitoring Using Spark-Induced Breakdown Spectroscopy (SIBS)
Hunter, Amy J.R.; Joseph R. Morency; Constance L. Senior; Steven J. Davis; Mark E. Fraser.
Journal of the Air and Waste Management Association, Vol 50 No 1, p 111-117, 2000

A new technology for monitoring airborne heavy metals on aerosols and particulates based on spark-induced breakdown spectroscopy (SIBS) was evaluated at a joint EPA/DOE test at the Rotary Kiln Incinerator Simulator (RKIS) facility at EPA/RTP in September 1997. The instrument was configured to measure lead and chromium in a simulated combustion flue gas in real time and in situ at

target levels of 15 and 75 µg/dscm. Actual metal concentrations were measured during the tests using EPA Reference Method 29. The SIBS technology detected both lead and chromium at the low- and high-level concentrations, and the hardware performed without failure for >100 hours of operation to acquire data for 100% of the reference method tests. The chromium data agreed well with concentration increases resulting from duct operations and pressure fluctuations that are known to entrain dust.
http://www.psicorp.com/html/pubs/Abst/sr-0928a.htm

Continuous Monitoring of Toxic Metals in Gas Flows Using DC-Plasma Excited Atomic Absorption Spectroscopy
Oikari, Risto; Ville Häyrinen; Tomi Parviainen; Rolf Hernberg, Tampere Univ. of Technology, Inst. of Physics, Tampere, Finland.
Applied Spectroscopy, Vol 55 No 11, Nov 2001

A measurement apparatus employing DC-plasma excited atomic absorption spectroscopy has been developed and demonstrated for continuous measurement of toxic metals in process gases and can withstand wet, corrosive, and particulate-laden flue gases at temperatures up to 1100°C. The detection limits of the current prototype are 0.04 mg/m^3 for cadmium and 0.4 mg/m^3 for lead. The measurement accuracy is better than 20% and the maximum measurement rate is about 100 values per minute.

Cost and Performance Report for Tri-Service Site Characterization and Analysis System (SCAPS): Thermal Desorption Samplers for Volatile Organic Compounds
Myers, K. F., et al., U.S. Army Engineer Research and Development Center, Vicksburg, MS.
Report No: ERDC/EL TR-01-6, 46 pp, 2001

The thermal desorption sampler (TDS), developed for the Site Characterization and Analysis Penetrometer System (SCAPS) program provides in situ analysis of volatile organic compounds (VOCs) in vadose zone and saturated soils. In operation, the TDS captures an estimated quantity of soil below ground, thermally desorbs the VOCs, and transfers them to the surface where they are analyzed on a field portable ion trap mass spectrometer (ITMS). This analysis is sensitive to the low ppb range for chlorinated solvents and BTEX compounds. The TDS was field tested at five geologically distinct sites across the country. Field data were compared to laboratory data (U.S. EPA SW-846 Method 8260B) for validation of the technique. Data analysis indicated that the in situ analysis of the primary VOC contaminant at each site demonstrated good correlation with the validation method with a liner regression correlation coefficient between 0.8 and 1.0 and the slope of the regression line between 0.7 and 1.3. Secondary VOC contaminants of lesser concentration, demonstrated poorer correlation that could be attributed to the lack of chromatographic separation prior to the ITMS analysis. Cost of operating the TDS system was compared to conventional sample collection and analysis techniques. The main savings produced by using this system were a reduction in time spent characterizing a site, the reduced exposure of workers to contaminants, and the minimization of investigation wastes.
http://www.wes.army.mil/el/elpubs/genrep.html

Cost and Performance Report for the Tri-Service Site Characterization and Analysis Penetrometer System (SCAPS) Hydrosparge Volatile Organic Compound Sensor
Costanza, Jed (Naval Facilities Engineering Service Center, Pearl Harbor, HI); Karen F. Myers (Environmental Lab., U.S. Army Engineer Research and Development Center, Vicksburg, MS), William M. Davis.
Report No: ERDC/EL TR-01-10, 46 pp, Jun 2001

The Hydrosparge VOC sensor was developed for the Tri-Services Site Characterization and Analysis Penetrometer System (SCAPS) program to provide in situ VOC detection in ground waters. The system consists of a direct push well for groundwater access, an in situ sparge module, and a direct-sampling ion trap mass spectrometer. During ESTCP-funded demonstration, the Hydrosparge VOC sensor was tested at three geographically different sites across the country. The results obtained with the SCAPS in situ technique indicated a strong linear relationship with EPA methods with regression coefficients ranging between 0.63 and 0.88 and the slope of the regression line between 1.1 and 1.2. During the cost and performance demonstration for this report, Hydrosparge VOC sensor directed placement of a reduced number of conventional monitoring wells with a substantial reduction in time and cost.
http://www.wes.army.mil/el/elpubs/genrep.html

Design and Development of the Image Scanner for Lineate Imaging Near Ultraviolet Spectrometer (LINES)
Kompatzki, Richardo C., Master's thesis, Naval Postgraduate School Monterey CA.
DTIC Order No: ADA386570. 98 pp, Dec 2000

The Lineate Imaging Near Ultraviolet Spectrometer (LINES) is a spectral imager that works in the ultraviolet region of the spectrum, and its purpose is to study atmospheric gas plumes. This thesis project is part of an ongoing effort to field-test the first version of LINES by mid-2001. It concentrates in the development of the ultra-precise servo system that controls the pointing/scanning system of the instrument. The closed-loop angular-position servo is controlled by a dedicated motion controller board that is installed in the host computer. Control of the servo is achieved through proportional-integral-derivative (PID) algorithms built into the hardware and firmware of the motion controller board. The servo has been designed to an angular resolution of 9 seconds of arc, and was tuned for a step of 1000 counts. Static and dynamic tests were conducted and showed that the servo is stable and accurate. The tested accuracy of the servo is well within the design goal of one half encoder count.
The full text of this report is available in PDF through the DTIC search engine at
http://stinet.dtic.mil/str/tr_fields.html

Detection and Quantitation of *gfp* and *luc*-Tagged Bacteria in Environmental Samples
Jansson, Janet K.; Annelie Moller; Annika Unge; Riccardo Tombolini, Dept. of Biochemistry, Stockholm Univ., Stockholm, Sweden.
MAREP International Conference on Marker/Reporter Genes in Microbial Ecology, 14-17 June 1997, Stockholm, Sweden. Extended Abstracts.

The researchers have focused on the development of methods for quantitation of bacteria that are tagged with marker genes that endow the cells with a luminescent or fluorescent phenotype. Specificity of the marker gene is very important, particularly for monitoring a particular microbial species in environmental samples, such as soil, that contains billions of microbial cells and thousands of distinct

genotypes in a single gram. Sensitivity of detection of the marked bacteria is also critical, since the tagged microbial species can be present in environmental samples at very low numbers and therefore difficult to detect. The authors have focused on marker genes that are strong with regard to specificity and sensitivity of detection: the firefly luciferase gene, luc; the bacterial luciferase gene, lux; and the green fluorescent protein (GFP) gene, gfp. Bacteria tagged with these marker genes can be specifically identified on the basis of their unique phenotype by optical methods and on the basis of their unique genotype by competitive PCR.
Extended abstracts available at http://www.sh.se/marep/program.html

Detection Limit and Decision Thresholds in Spectrometry
Meray, L.; O. Demeny, Dept. of Physics, Univ. of Veszprém, Veszprém, Hungary.
Applied Spectroscopy, Vol 55 No 8, Aug 2001

This paper introduces a critical approach to the conventional definition of the detection limit and the decision threshold. Equations describing the probability of having more (or less) sample present than a given lower (or upper) limit are derived using two different methods based on probability theory to calculate the value of net counts. Examples from low count experiments and simulations illustrate the concepts.

Detection of Atmospheric Pollutants by Pulsed Photoacoustic Spectroscopy
Roman, M. (National Institute for Laser, Plasma, and Radiation Physics); M.L. Pascu; A. Staicu.
ROMOPTO '97: Fifth Conference on Optics.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 3405, p 1215-1219, 1998

In pulsed laser photoacoustic detection of NO_2 and SO_2, the laser source was a pulsed molecular nitrogen laser emitting at 337.1 nm with average energy per pulse of about 350 µJ and a pulse duration of 10 nsec. The researchers used a piezoelectric transducer (TUSIM-N.I.M.P., resonance frequency 4 MHz) and an electret condenser microphone (Trevi EM 27). The photoacoustic cell was a nonresonant one, with a cylindrical shape. The laser beam was centered along the cylinder axis, and linear dependence of the photoacoustic signal on pollutant pressure was obtained. The photoacoustic signal was measured for pollutant pressure between 1 torr and 100 torr for NO_2 and between 35 torr and 100 torr for SO_2.

Detection of Chlorinated and Fluorinated Substances Using Partial Discharge Ion Mobility Spectrometry
Schmidt, H.; J.I. Baumbach; P. Pilzecker; D. Klockow, Inst. of Spectrochemistry and Applied Spectroscopy, Dortmund and Berlin, Germany.
International Journal of Ion Mobility Spectrometry, Vol 3, p 8-14, 2000

Radioactive nickel foils (63Ni), so far most frequently used in ion mobility spectrometry, are expected to be partly replaced by nonradioactive alternatives for ionization of analyte molecules, for instance partial discharge sources. A partial discharge ion mobility spectrometer was used for the detection of selected volatile halogenated compounds containing chlorine, as well as fluorine atoms. This paper presents and discusses spectra of trans-1,2-dichloroethene, trichloroethene, tetrachloroethene, and perfluorohexane measured with the developed ion mobility spectrometer (IMS).

Detection of Hydrocarbons in Water by MIR Evanescent Wave Spectroscopy with Flattened Silver Halide Fibers

Hahn, P.; M. Tacke; M. Jakusch; B. Mizaikoff; O. Spector; A. Katzir, Fraunhofer Inst. Physikalische Messtechnik, Freiburg, Germany.
Applied Spectroscopy, Vol 55 No 1, Jan 2001

In an attenuated total reflection (ATR)-type setup, IR-transmitting $AgCl_xBr_{1-x}$ fibers were used as internal reflection elements for the spectroscopic detection of hydrocarbons dissolved in water. The fibers were partly flattened by pressing and then coated with an analyte-enriching organic polymer to increase sensor sensitivity. A portable tunable diode laser spectrometer served as a spectrometric unit. The sensitivity of the flattened waveguide with a thickness of 170 μm was enhanced by a factor of 5 compared to a fiber with 900 μm diameter. Aqueous toluene solutions with concentrations in the ppm range were used to characterize the sensor system that showed a linear response with regard to analyte concentration.

Detection of Trans-1,2-Dichloroethene, Trichloroethene and Tetrachloroethene Using Multi-Capillary Columns Coupled to Ion Mobility Spectrometers with UV-Ionisation Sources

Sielemann, S.; J.I. Baumbach; P. Pilzecker; G. Walendzik, Inst. of Spectrochemistry and Applied Spectroscopy, Dortmund and Berlin, Germany.
International Journal for Ion Mobility Spectrometry, Vol 2, p 15-21, 1999

In investigations of mixtures of analytes using ion mobility spectrometers (IMS), peak overlapping and additional peaks, occurring because of dimers containing different molecules of the analytes, often reduce the resolution of the spectra. The influence of inter-molecular charge transfer reactions on the signal should be reduced by time-delayed sample introduction into the ionization regions of the IMS realized by coupling Multi-Capillary Columns (MCC) to the IMS. The aim of this combination is to achieve further enhancement of the resolution of the instrument and to significantly increase the scope of application of ion mobility spectrometry. The response of a UV-IMS to trans-1,2-dichloroethene, trichloroethene, and tetrachloroethene and the advantages of the combination of MCC with ion mobility spectrometers will be discussed.

Determination of Arsenic Species in Soils

Garlic, Haman, Ph.D. dissertation, Univ. of Massachusetts at Amherst.
University Microfilm, UMI Pub No AAT 3012132. ISBN 0-493-21894-7, 146 pp, 2001

The objective of this study was to develop new methods for the determination and speciation of arsenic in soils. Ion-pairing chromatography was used for the separation of 4 toxicologically important arsenic species (As(III), As(V), monomethylarsonic acid (MMAA), and dimethylarsinic acid (DMAA)). Hydride generation atomic absorption spectrometry (HG-AAS) or inductively coupled plasma mass spectrometry (ICP-MS) was used for detection. Extraction of arsenic species from soils was achieved using shaking, sonication, and microwave-assisted extraction. Even though As(V), DMAA and MMAA were quantitatively extracted from spiked soils, the recoveries for As(III) were low due to its irreversible adsorption into the soil. To determine acid-extractable arsenic in soils, a procedure based on flow injection and slurry sampling with on-line microwave extraction (SS-MW-HG-AAS) was developed. The on-line microwave extraction increased the recovery of the adsorbed arsenic from 30 to 70%. The manifold was also successfully coupled to an ICP-MS for the multielemental analyses of soils. To eliminate the use of liquid nitrogen for the speciation of arsenic using cryo trapping, a thermal desorption instrument equipped with a Peltier cooler was employed. The arsines from the HG manifold were directed into the U-tube of the instrument, which is kept at -30 degrees C. At this temperature, arsine eluted with little retention but the organo-arsines were trapped and then released after arsine completely eluted. A new nebulizer design that provides better sensitivity than commercially available nebulizers is described. This nebulizer is constructed by inserting one fused silica capillary into another and then inserting this double capillary system into a PEEK tube (Double Capillary Nebulizer-DCN). Unlike the conventional concentric nebulizers where the argon delivery is from the outer area, the uniqueness of this nebulizer was the delivery of the argon from the inner and outer parts of the liquid flow to increase the efficiency of the interaction between the liquid and the gas. The performance of the DCN was comparable to the Meinhard nebulizer and some of the DCNs prepared were found to perform even better. The cost of a DCN is approximately 15% of the price of a Meinhard nebulizer.

Determination of Formaldehyde in Water by Anion Exchange Solid Sorbent Methods with Gas Chromatography/electron Capture Detection and Gas Chromatography/Mass Spectrometry
Tso, J., and S. Que Hee, UCLA, Los Angeles, CA.
American Industrial Hygiene Conference & Exposition, 2-7 June 2001, New Orleans, Louisiana

The aim of this study was to use distillation and anion exchange solid sorbent methods to remove formaldehyde from water and analyze the derivatives of formaldehyde with O-(2,3,4,5,6-pentafluorobenzyl) hydroxylamine hydrochloride (PFBHA). The efficiency of removing formaldehyde from water by distillation with potassium permanganate is 60±4%. Distillation in nitrogen with less risk of formaldehyde dissolving in water from the air had an efficiency of 75%. Anion exchange sorbents removed formaldehyde at concentrations of 200±30 ppb from water with efficiencies of 68±5%. The linear range for formaldehyde-PFBHA oxime ranged from 30-1440 pg by GC/ECD and 3.5-70 ng by GC/MS with selective ion monitoring (SIM) of m/z 181.

Determination of Mercury Species Using ICP/MS Techniques
Hintelmann, Holger, Trent Univ., Dept. of Chemistry, Peterborough, Canada.
Proceedings of the 11th International Conference on Heavy Metals in the Environment, 6-10 August 2000, Ann Arbor, MI.
University of Michigan, School of Public Health, Paper No 1104, CD-ROM, 2000.

This paper presents an overview of different analytical methods using ICP/MS as a detector to determine mercury species in environmental samples. Total mercury is measured using either cold vapor flow injection analysis or cold vapor gold amalgamation preconcentration. Both techniques have absolute detection limits of approximately 1 pg of Mercury per isotope. Methylmercury is determined after GC separation on-line by ICP/MS. These techniques are used to carry out isotope dilution analyses and stable isotope tracing experiments. For such measurements, the achievable isotope ratio precision is of critical importance. The RSD for isotope ratio measurements was in the range of 0.5 to 2%, depending on the individual method used.

Determination of Ultratrace-Level Fluorescent Tracer Concentrations in Environmental Samples Using a Combination of HPLC Separation and Laser-Excited Fluorescence Multiwavelength Emission Detection: Application to Testing of Geothermal Well Brines
Kleimeyer, J.A.; P.E. Rose; J.M. Harris, Dept. of Chemistry, Univ. of Utah, Salt Lake City.
Applied Spectroscopy, Vol 55 No 6, Jun 2001

The researchers have developed a high-sensitivity multiwavelength fluorescence detector for HPLC-separated samples. The fluorescence flow-cell utilizes fiber-optic coupling of laser excitation and the collected emission, which is dispersed in a short spectrograph and detected using a cooled, charge-coupled device (CCD). The HPLC separation step not only resolves the target tracer from fluorescent impurities in the sample, but also transfers the dye molecules into a solution of reproducible composition that provides a constant Raman scattering background against which the tracer fluorescence spectrum may be detected. The combination of emission-wavelength and elution-time measurement provides a multidimensional data set that improves selectivity for detecting a tracer.

Development and Application of In-Situ Monitoring and Bioassay Technologies for Assessing Groundwater Contamination
Gustavson, Karl Eric, Ph.D. dissertation, Univ. Of Wisconsin - Madison.
University Microfilm, UMI Pub No AAT 3015433. ISBN: 0-493-25007-7. 143 pp, 2001

The goal of this research was to further evaluate the submitochondrial particle (SMP) bioassay as a surrogate for whole organisms in toxicity assessments. Studies conducted to establish SMP assay relevance as replacements for well-established whole organism assays included a correlation analysis between the results of SMP and multiple human-cell-line assays on a standard series of compounds of human toxicologic interest, and a mechanism of toxic action study on the n-alkanols. To further pursue the use of the SMP assay in environmental monitoring, ground water from a pesticide production facility was tested using the SMP bioassay in conjunction with other biologic, chemical, and toxicity identification evaluation (TIE) analyses. Also, long-term in situ chemical concentration devices (semipermeable membrane devices, or SPMDs) were evaluated for use in combination with the SMP assay. The SPMDs were deployed in ground water at a former manufactured gas plant contaminated with polynuclear aromatic hydrocarbons (PAHs). Accumulated PAHs were compared to residues from conventional ground water sampling techniques. Prior to using SPMD extracts in bioassay analyses, a novel solid-phase extraction (SPE) cleanup method was devised using a restricted-access sorbent to remove an SPMD-derived interference. SPMD extracts and raw ground-water extracts were subsequently tested in the SMP and Microtox bioassays and compared to analytically determined chemical concentrations to evaluate the combination of these technologies for describing the extent of ground-water contamination.

Development and Applications of Laser-Enhanced Ionization, Laser-Induced Fluorescence, and Photoionization Detection Systems for Trace Detection of Elements and Compounds of Environmental and Biological Significance
Elwood, Seth Aaron, Ph.D. dissertation, Univ. of Iowa.
University Microfilm, UMI Pub No AAT 3009586. ISBN: 0-493-19087-2. 211 pp, 2001

Laser-based detection systems (laser-enhanced ionization (LEI), laser-induced fluorescence (LIF), and photoionization spectrometry (PIS)) have been developed and applied to the determination of several elements in aqueous and solid media and nitric oxide and related compounds in the gas phase. Laser-enhanced ionization determinations of Cu, Sb, As, and Se have been carried out in a flame atomizer using far-ultraviolet transitions that have not been utilized previously. The limits of detection (LOD's) achieved for these elements by LEI in an argon/ oxygen/ acetylene flame are the best achieved for any analytical flame-based analysis technique for these elements. The elements As, Se, and Sb are all amenable to the hydride generation (HG) sample introduction technique. This technique has been combined with high sensitivity LIF detection in a flame atomizer, and the LODs obtained are equal to or better than any other technique reported. This HG-LIF system has been applied to a feasibility study of the phytoremediation of As by poplar plants. In addition, the speciation of As and Se has been demonstrated using sequential analysis techniques, along with online separation of the species by ion chromatography (Se) or high performance liquid chromatography (As).

The Development of a Bioluminescent Bacterial Sensor for Copper in Soil Samples
Nybroe, Ole; Andreas Tom-Petersen; Christian Straarup, Dept. of Ecology, Royal Veterinary and Agricultural Univ., Frederiksberg, Denmark.
MAREP: Marker/Reporter Genes in Microbial Ecology, Second International Conference, 4-7 December 1999, Stockholm, Sweden. Book of Abstracts, p 8, 1999

The researchers have identified copper-inducible chromosomal loci in *Pseudomonas fluorescens* strain DF57 by Tn5::luxAB mutagenesis. The mutants responding specifically to copper were tagged in loci encoding proteins homologous to Cop proteins from P. syringae or to a heavy metal ATPase from *Proteus mirabilis*. The mutants had variable induction properties and copper tolerances. The DF57-Cu15 mutant strain was the most sensitive reporter and had a copper tolerance comparable to that of the wild type strain. This strain was used to measure the biologically available amount of copper in the soil by an indirect assay, where it was exposed to copper in a soil extract. The strain induced bioluminescence at ~1 ppm copper, and the response increased until a toxic copper level was reached at ~50 ppm. Amendment of the soil with EDTA lead to a decreased expression of bioluminescence, probably due to the ability of EDTA to bind copper ions. To obtain a more realistic way of exposing the cells to copper, the cells were mixed with the copper-containing samples and left in the soil for two days before cells were extracted and bioluminescence was measured. In studies of time-dependent changes in the biological availability of copper introduced to a natural soil, DF57-Cu15 detected no changes in available copper during a 6-months incubation under stable conditions. The researchers are investigating how fluctuations in abiotic parameters such as water content of the soil affect the availability of this metal.
Book of abstracts available at http://www.sh.se/marep/congr2test.html

Development of a Biosensor for Atrazine
Das, Neema; Kenneth F. Reardon, Colorado State Univ., Ft. Collins, CO
The 2000 Conference on Hazardous Waste Research: Environmental Challenges and Solutions to Resource Development, Production, and Use, 23-25 May 2000, Denver, Colorado
Great Plains/Rocky Mountain Hazardous Substance Research Center, Manhattan, KS.

The aim of this study is to design a biosensor to measure atrazine concentration in ground water. The biosensor is based on measurement of pH change, which is proportional to the concentration of atrazine. The tip of the biosensor is coated with two layers; the first layer contains a pH-sensitive fluorescent dye, and the second layer contains bacteria (Pseudomonas sp. ADP or Clavibacter michiganese sp. ATZ1) immobilized in an alginate medium. These microorganisms use atrazine as a substrate and produce HCl. The production of acid lowers the pH, and this change is detected by the first layer. The biosensor made from Clavibacter has shown high specificity for atrazine in comparison to other commonly found ground-water contaminants (toluene, ethylacetate, and chlorobenzene) and naturally occurring chemicals. It has high sensitivity, with a detection limit of 1 ppb (the lowest measurement taken is 60 times the background noise). The response of this biosensor is linear for atrazine concentrations from 1 ppb to 100 ppb. It has high reproducibility at low concentrations. Most of the total signal change (95%) is observed in 10 minutes, which is one-third of the response time. It loses 45% of its activity in 6 days. http://www.ecc.ksu.edu/HSRC/Abstracts00.html

Development of a High-Speed Ultraviolet Spectrometer for Remote Sensing of Mobile Source Nitric Oxide Emissions
Popp, Peter J.; Gary A. Bishop; Donald H. Stedman, Univ. of Denver, Denver, CO.
Journal of the Air & Waste Management Association, Vol 49 No 12, Dec 1999

The University of Denver (DU) has developed a remote sensor for the measurement of mobile-source nitric oxide (NO). This system is integrated with an existing infrared remote sensor and is capable of measuring carbon monoxide and hydrocarbons in addition to NO, at a rate of more than 1000 vehicles per hour.

Development of a Real-Time Continuous Emissions Monitor for Polychlorinated Dioxins and Furans
Oser, Harald (SRI International, Molecular Physics Lab., Menlo Park, CA); M.J. Coggiola; G.W. Faris; D.R. Crosley.
Laser Applications to Chemical and Environmental Analysis, 11-13 February 2000, Santa Fe, New Mexico. Technical Digest, Postconference Edition.
Optical Society of America, Washington, DC. TOPS Vol 36, p 94-96, 2000

SRI International has begun a project designed to meet the need for a continuous emissions monitor for the determination of dioxins and furans at realistic (ppt or sub-ppt) concentrations in real time (minutes). The instrument is based on supersonic jet expansion and cooling, followed by resonantly enhanced multiphoton ionization (REMPI) into a mass spectrometer. This combination furnishes the dual selectivity of tuned laser absorption and mass analysis. SRI has made direct measurements of several polychlorinated dioxins and furans using a one-color REMPI scheme, and it also has demonstrated a two-color excitation scheme.

Development of an Ion Chromatographic System Suitable for Monitoring the Gold Cyanidation Process
Fagan, Peter Andrew, Ph.D. dissertation, Univ. of Tasmania, Australia. Submitted June 1998, 300+ pp.

The aim of this project was to further develop an ion chromatographic method for monitoring the gold cyanidation process with respect to copper-gold ores. The lability of the Cu(I)-cyanide complexes may result in reporting of erroneously high levels of cyanide; this problem can be overcome by reporting the ratio of cyanide to copper in solution. Reversed phase ion interaction chromatography (RPIIC) with direct UV detection was used to enable speciation and determination of individual metal cyanide complexes. Because CN^- is UV transparent, a post-column reaction (PCR) system based on the Konig reaction scheme was used to determine the free cyanide. The free cyanide was only slightly retained during the separation of the metal cyanide complexes. The CN component in thiocyanate and the Cu(I) and Ag(I) cyanide complexes were also derived by the PCR. When CN^- , SCN^- , and the Cu(I) and Ag(I) complexes were all separated, the resultant PCR detector chromatogram was complementary to the UV detector chromatogram. To quantify the effect of any potential interferences on the free cyanide, a second separation system was coupled to the RPIIC separation system. The free cyanide band was injected onto an ion exclusion column, enabling separation as HCN. Several gold mine samples were analyzed with the free cyanide determined both before and after separation on the ion exclusion column. These free cyanide results found no difference between the two hardware configurations. Consequently, the simplest hardware configuration was employed, with the PCR detection system connected directly to the outlet of the UV detector. Testing at an operational gold mine showed some severe problems. Further development and application of the IC methods were then conducted, and two major methods were developed. The first method involved rapid determination of

R using the CN:Cu(I) peak area ratio obtained from the PCR detector chromatogram. This analysis can tolerate a large range of Cu concentrations and the calibration drift is minimal over a period of weeks. The second method involved rapid determination of cyanate in leachates containing large concentrations of metal cyanide complexes. Using all the information provided by these IC methods enabled a mass balance to be determined to within 5%.
http://www.library.unsw.edu.au/~thesis/adt-root/public/adt-NUN1999.0040/

Development of Eco-Sensor Based on Lipid Membrane
Ishimori, Yoshio (Toshiba Corp.); H. Tamura; K. Kawano; N. Aoyama; E. Tamiya (Japan Advanced Institute of Science and Technology).
Water, Ground, and Air Pollution Monitoring and Remediation.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 4199, p 43-50, 2001

The researchers have developed an eco-sensor for the continuous monitoring of ground water in industrial areas. The sensor is based on lipid membranes and has a sensitivity to organochlorine compounds on the order of 10 ppb using monoolein bilayer lipid membranes (BLMs). Work has been done to stabilize the supporting structure of the BLMs, as well as to develop an automatic BLMs preparation device by use of an inkjet mechanism. A decrease in sensitivity has been observed over time in the storage of the sensor, and work continues on extending the life of the device.

Development of Electrochemical Sensors for Trace Detection of Explosives and for the Detection of Chemical Warfare Agents
Berger, T. (Fraunhofer-Institut fuer Chemische Technologie); H. Ziegler; M. Krausa.
Detection and Remediation Technologies for Mines and Minelike Targets V.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 4038, p 452-461, 2000

This paper describes the results of research to develop an electrochemical mine detection system for locating TNT, RDX, HMX, and chemical warfare agents via the efficiency of cyclic voltammetry. The high sensitivity of electrochemical sensor methods makes possible the detection of chemical substances with a low vapor pressure; e.g., the vapor pressure of TNT at 7 ppb at room temperature. The researchers were able to measure TNT approximately 10 cm above a TNT sample and in the gaseous phase approximately 10 cm above a real plastic mine.

Development of Monitors for Assessing Exposure of Military Personnel to Toxic Chemicals
Petty, Jimmie D., U.S. Geological Survey, Columbia, MO. Biological Resources Div.
NTIS: ADA376877. 111 pp, Jan 2000

Scientists at the USGS Columbia Environmental Research Center have developed and patented a semipermeable membrane device (SPMD) for integrative monitoring of hydrophobic chemicals. The objective of the research project was to develop a prototype Area Monitor based on the concept of integrative sampling and then to expand this approach to monitor more hydrophilic chemicals, toxic metals, and vapor-phase neutral metals. Application of bioindicator tests designed to define exposure to complex chemical mixtures having various modes of action provides a unique approach for determining not only the presence of a wide array of toxic chemicals, but also their potential toxicological significance. During the course of the project, integrative samplers for airborne vapor-phase metals--mercury, waterborne ionic metals (i.e., Cd, Cu, Ni, Pb, and Zn), and waterborne hydrophilic organic chemicals--were designed and developed. Also, the incorporation of bioindicator

tests to define the toxicological relevance of exposure to complex mixtures of chemicals was validated. In combination with the SPMD technology, the research described in this report has resulted in the development and proof-of-concept validation of technology forming the basis of Area Monitors for use by the DoD in situations requiring exposure assessment. Further refinements of the technology, including miniaturization and remote sensing approaches are possible.
The full text of this report is available in PDF through the DTIC search engine at http://stinet.dtic.mil/str/tr_fields.html

Differential Pulse Voltammetric Determination of Low µg L^{-1} Cyanide Levels Using EDTA, Cu(II) and a Hanging Mercury Drop Electrode
Gonzalez LaFuente, J.M. (COGERSA, Solid Waste Mgmt. of Asturias, La Zoreda, Serin, Gijon, Asturias, Spain); E. Fernandez Martinez; J.A. Vicente Perez; S. Fernandez Fernandez; A.J. Miranda Ordieres; J.E. Sanchez Uria; M.L. Fernandez Sanchez; A. Sanz-Medel.
Analytica Chimica Acta, Vol 410 No 1-2, p 135-142, 2000

The method proposed in this paper for cyanide determination at the ultratrace level by differential pulse voltammetry is based on the sensitivity enhancement obtained when both Cu(II) and EDTA are present in the supporting electrolyte. Cyclic voltammetry indicates that the measured cyanide peak is obtained when the electrogenerated CuCN adsorbed onto the hanging mercury drop electrode surface is oxidized during the positive potential scan. The method was successfully applied to various industrial waste waters such as metal-finishing waste waters, water/sand mixtures from cleaning processes of coke production, leachates from wastes obtained from electrolytic cells of aluminum production, and liquors from gold extraction industry. Results obtained by the proposed method showed good agreement with those obtained by ion-selective potentiometry and the spectrophotometric pyridine method.

Direct and In-Situ Speciation of Arsenic in Microbial Mats and Sediments Using X-ray Absorption Spectroscopy
Foster, A.L.; R.P. Ashley; J.J. Rytuba, U.S. Geological Survey, Menlo Park, CA.
USGS Workshop on Arsenic in the Environment, 21-22 February 2001, Denver, CO

The mobility and toxicity of arsenic (As) is related to its speciation (defined as oxidation state and coordination environment). The speciation of arsenic in natural solids (such as sediments) and mixed solids/liquids (such as microbial mats) is usually determined via indirect methods requiring significant sample preparation that may result in alteration or redistribution of As species. The researchers have employed X-ray absorption spectroscopy (XAS), which includes X-ray absorption near edge spectroscopy (XANES) and extended X-ray absorption fine structure spectroscopy (EXAFS), to determine As species in ore material from the Lava Cap gold mine and in tailings and microbial mats from nearby Lost Lake.

Direct Determination of Metals in Soils and Sediments by Induction Heating-Electrothermal Vaporization (IH-ETV) Inductively Coupled Plasma-Optical Emission Spectrometry (ICP-OES)
Rybak, Michael E.; Eric D. Salin, Dept. of Chemistry, McGill Univ., Montreal, Quebec, Canada.
Applied Spectroscopy, Vol 55 No 7, Jul 2001

An induction heating (IH) electrothermal vaporization (ETV) sample introduction arrangement can be used to determine As, Cd, Cu, Mn, Pb, and Zn in soils and sediments by inductively coupled plasma-optical emission spectrometry (ICP-OES). Samples deposited either directly as a solid or by means of slurry sampling into graphite cups were positioned in a radio-frequency (RF)-field and vaporized in a carrier flow of 15 % (v/v) SF6-Ar. Aqueous standard solutions were used for the analysis of four certified reference materials by standard additions, resulting in recoveries ranging from 54 to 139% across all six determined elements in all four samples. In general, sample delivery was simpler and the observed signal precision was better with slurry sampling when compared to the analysis of the solid directly.

Distributed Fibre Optic Sensors for the Detection of Liquid Spills
MacLean, Alistair (Univ. of Strathclyde, Scotland), Walter Johnstone, Brian Culshaw, Chris Moran; Dan Marsh (PINACL Communications, Rhyl, Denbighshire, UK), Geoff Andrews.
Proceedings of the 2nd International Symposium and Workshop on Time Domain Reflectometry for Innovative Geotechnical Applications, 5-7 September 2001, Northwestern University, Evanston, IL. Infrastructure Technology Institute, Northwestern University, Evanston, IL. ISBN: 0-9712631-0-8.

This paper examines distributed fibre optic sensors for the detection and location of aqueous, chemical and hydrocarbon fluid spills. The sensors incorporate polymers that convert the swelling into a localized loss on an optical fibre when fluid exposure occurs. Optical Time Domain Reflectometry (OTDR) techniques are employed to rapidly detect and locate target liquids and chemicals at multiple positions along the sensor length. Sensor exposure to fluid can typically be located within 30 seconds to an accuracy of 2 m over a total length of 10 km. Once the polymer has dried out, the sensor returns to a non-activated state in which it can detect further spill events. The authors cover basic sensor construction and underlying technology; results from experimental tests of prototype sensors manufactured to detect water, humidity, hydrocarbon fuels and organic solvents; response characteristics of the sensors in a range of varying environmental conditions; performance in practical field trials; important advantages of the sensor design; and the range of applications where they can be effectively implemented.
http://www.iti.northwestern.edu/tdr/tdr2001/proceedings/tdr2001.zip [Note: This is a very large file!]

Distributed Sensor Particles for Remote Fluorescence Detection of Trace Analytes: UXO/CW
Singh, A.K.; A. Gupta; A. Mulchandani; W. Chen; R.B. Bhatia; J.S. Schoeniger; C.S. Ashley; C.J. Brinker; B.G. Hance; R.L. Schmitt; M.S. Johnson; P.J. Hargis Jr.; R.J. Simonson.
Report No: SAND2001-3522, 23 pp, Nov 2001

This paper summarizes the development of sensor particles for remote detection of trace chemical analytes over broad areas, such as residual TNT from buried landmines or other unexploded ordnance (UXO). The sensor particle approach also shows potential for the detection of chemical warfare (CW) agents. The primary goal of the research has been the development of sensor particles that incorporate sample preconcentration, analyte molecular recognition, chemical signal amplification, and fluorescence signal transduction. The researchers explored two approaches for particle-based chemical-to-fluorescence signal transduction: enzyme-amplified immunoassays using biocompatible inorganic encapsulants, and oxidative quenching of a unique fluorescent polymer by TNT.
http://www.osti.gov/bridge/product.biblio.jsp?osti_id=789593

DRES Chemical Warfare Agent Literature Database of Analytical Methods
D'Agostino, Paul A.; J.R. Hancock; L.R. Provost, Defence Research Establishment Suffieldralston (Alberta, Canada).
Report No: DRES-SSP-2001-014, NTIS: ADA389257. 37 pp, Jan 2001

Defence Research Establishment Suffield (DRES) is actively involved in the development and evaluation of new analytical methods for the detection and identification of chemical warfare agents, their degradation products, and related compounds. These methods are used for the analysis of samples collected in support of the Canadian Forces and have application in arms control verification. DRES analytical methods are published regularly in the open literature along with the methods developed by others involved in chemical warfare agent sample preparation and analysis. DRES retains printed copies of all publications in the database and regularly updates the bibliographic information from these papers into Procite, a computer searchable bibliographic database program. The DRES Chemical Warfare Agent Literature Database of Analytical Methods contains bibliographic information for more than 260 publications, and is available on request in hard copy or as a Procite, Word, or WordPerfect file.

Dual-Beam Near-Infrared Hadamard Spectrophotometer
da Silva, H.E.B.; Celio Pasquini, Inst. de Quimica, Univ. Estadual de Campinas, Campinas, SP, Brazil.
Applied Spectroscopy, Vol 55 No 6, Jun 2001

A dual beam Hadamard multiplexed spectrophotometer works in the near infrared region of the electromagnetic spectrum (900-1800 nm) based on the use of a linear Hadamard mask containing 255 multiplexing elements. Simple symmetric Czerny-Turner optics were employed based on 10 cm diameter, 20 cm focus spherical mirrors, and a plane grating containing 295 grooves mm-1. The dual path system employs the multiplexed beam exiting from the mask, which can then be split using either an integrating sphere, a bifurcated optical bundle, or a beam splitter. Two cooled PbS or InAs detectors were collected the 255 multiplexed intensities in about 8 seconds. The instrument can correct for the drift of the light source intensity. The average standard deviation for absorbance measurements taken is about three times lower than obtained for the single beam multiplexed approach. The instrument has been applied to the determination of water in fuel ethanol using PLS modeling.

The Effect of 4-Chlorophenol on a Biodegrading Inoculum and Natural Microbial Fingerprint Patterns in Soil
Jernberg, Cecilia; Janet K. Jansson, Huddinge, Sweden.
MAREP: Marker/Reporter Genes in Microbial Ecology, Second International Conference, 4-7 December 1999, Stockholm, Sweden. Book of Abstracts, [poster presentation] p 32, 1999

The researchers combined different techniques to monitor the fate and efficacy of a bacterium introduced to soil microcosms for bioremediation purposes, as well as to monitor the natural microbial population in the soil. Fingerprints of the microbial community patterns in soil microcosms with or without the addition of the toxic compound 4-chlorophenol were obtained by T-RFLP, Terminal-Restriction Fragment Length Polymorphism. T-RFLP provides these fingerprints based on the determination of the different lengths of the terminal restriction fragments obtained from restriction digests of the 16S rRNA genes. Changes in these patterns indicate a disruption of the natural microbial community. One noticeable change was the appearance of a new ribotype (restriction fragment) that grew in intensity over time in soil microcosms with 4-chlorophenol. The novel bacterium *Arthrobacter*

chlorophenolicus A6, a bacterium that can degrade high levels of 4-chlorophenol (up to 350 ppm), was inoculated to the soil microcosms and monitored during 4-chlorophenol degradation. Due to its known 16S rDNA sequence, A6 could be specifically tracked and distinguished from the natural microbial population by T-RFLP. The decrease in 4-chlorophenol concentration was measured by gas chromatography during bioremediation. The A6 strain was also chromosomally tagged with the *luc* gene encoding the firefly luciferase enzyme, catalyzing a light emitting reaction (bioluminescence). Since the luciferase enzyme is energy dependent, the bioluminescence output could be used as an indicator of active cells in soil. The activity of the *luc*-tagged cells was monitored in the soil microcosms with and without 4-chlorophenol. The bioluminescence of the *luc*-tagged A6 cells in the microcosms with 4-chlorophenol was higher compared to soil microcosms without 4-chlorophenol addition, indicating that the cells were more metabolically active during the degradation of this toxic compound.
Book of abstracts available at http://www.sh.se/marep/congr2test.html

The Effect of Starvation and the VBNC State on GFP Fluorescence in Pseudomonas fluorescens
Lowder, Melanie (Univ. of North Carolina at Charlotte); Annika Unge (Stockholm Univ., Stockholm, Sweden), Janet Jansson; Jeanenne Swiggett (General Surgery Research Lab., Carolinas Medical Center, Charlotte, NC); James D. Oliver (Univ. of North Carolina at Charlotte).
MAREP: Marker/Reporter Genes in Microbial Ecology, Second International Conference, 4-7 December 1999, Stockholm, Sweden. Book of Abstracts, [poster presentation] p 37, 1999

The green fluorescent protein (GFP) gene, *gfp*, of the jellyfish Aequorea victoria is being used as a reporter system for gene expression and as a marker for tracking of prokaryotes and eukaryotes. Cells that have been genetically altered with the *gfp* gene exhibit a unique phenotype, green fluorescence, that allows the cells to be specifically monitored by nondestructive means. This study was concerned with determining whether a *gfp*-tagged strain of Pseudomonas fluorescens continues to fluoresce under conditions in which the cells are starved, or in the viable but nonculturable (VBNC) state. The studies suggest that *gfp*-tagged cells remain fluorescent following starvation and entry into the VBNC state, but that fluorescence is lost when the cells die. Thus, GFP fluorescence may be a reliable indicator for monitoring cells released to the environment.
Book of abstracts available at http://www.sh.se/marep/congr2test.html

Electrical Resistivity Imaging: an Innovative Tool for Geologic Characterization
Dean, Warren T., ATS International, Inc., Christiansburg, VA.
Association of Engineering Geologists & American Institute of Professional Geologists 2001 Joint Annual Meeting Abstracts. AEG News, Vol 44 No 4, p 59, Jul 2001

Traditional methods of subsurface investigation have relied on invasive techniques such as borings, monitoring wells, and direct-push technologies, but advances in hardware for the collection of electrical resistivity data allow the rapid, non-invasive collection of large amounts of subsurface data, and advances in computing power and modeling software allow the construction of two-dimensional and three-dimensional images of subsurface geology. This technique has been used successfully to image water table conditions prior to monitoring well installation, thereby minimizing the number of monitoring wells needed to characterize a site. Electrical resistivity (ER) imaging readily detects voids in karst terrain or abandoned mine areas, which can easily be missed by random boring. In terrains with highly irregular bedrock surfaces, it detects important peaks or valleys that might be missed by borings alone. It has been used to map contaminant plumes prior to implementing drilling plans, thereby maximizing the effectiveness of the drilling. Fracture zones are revealed with this technique, offering insight into preferred flow migration pathways for contaminants. The technique allows a more thorough characterization than can be achieved with invasive techniques alone.

Electrochemiluminescence of Ruthenium Polypyridyl Cyanide Complexes
Sabatino, Laura; Mark M. Richter, Southwest Missouri State Univ., Springfield, MO.
The Pittsburgh Conference: PITTCON 2001, 4-9 March 2001, New Orleans, Louisiana. Poster presentation No 1607P.

The electrochemiluminescence (ECL) of a ruthenium polypyridyl cyanide complex in acetonitrile and aqueous solutions was studied. Upon oxidation in the presence of tri-n-propylamine, an oxidative reductive coreactant, ECL was observed. ECL spectra corresponded with photoluminescence spectra, indicating the same metal-to-ligand charge-transfer states were formed in both ECL and photoluminescence. Efficiencies of ECL emission have been tabulated. The ability of the complex to bind CN has prompted an investigation into the use of these types of complexes for the detection of cyanide in aqueous samples using ECL.

Elemental Analysis Using NMR: Simultaneous Determination of Aluminum and Sodium in Zeolite A Using Low-Field NMR
Guiheneuf, Thierry M.; Larry S. Simeral, Albemarle Corp., Technical Center, Baton Rouge, LA.
Applied Spectroscopy, Vol 55 No 8, Aug 2001

The authors have demonstrated the determination of aluminum and sodium in zeolite A without sample preparation using multinuclear, low-field NMR. The simultaneous determination of aluminum and sodium can be performed in under five minutes with a precision of about 1% relative. This paper details the method, calibration, data collection, and significant other applications.

Emission Source Strengths of Gasoline-Filling Processes Determined by Open-Path Spectroscopic Techniques and Inverse Modeling
Schaefer, Klaus (Fraunhofer-Institut fuer Atmosphaerische Umweltforschung); Martina Stockhause; Herbert Hoffmann; Achim Sedlmaier; Stefan M. Emeis.
Spectroscopic Atmospheric Environmental Monitoring Techniques.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 3493, p 223-230, 1998

An estimation of the total emissions from a gas station and a gasoline tank farm was taken through non-intrusive measurements by a differential optical absorption spectroscopy (DOAS) system. The measurements determined the path-integrated concentrations of exhaust compounds downwind of the source through the whole exhaust plume. The total emission of gas stations with gasoline vapor recovery system was determined to be about 20 mg benzene per kg refueled gasoline, and emissions from refueling activities varied between 1 and 9 benzene per kg refueled gasoline, depending on the technical behavior of the gasoline vapor recovery system. Measurements taken on an open path through the middle of the gasoline tank farm showed a maximum 8 µg/(m2s) emission rate.

Environmental Mercury Speciation Analysis by Flow-Hyphenation Techniques
Tseng, C.M. (Univ. of Connecticut); O.F.X Donard (Laboratoire de Chimie Bio-Inorganique et Environnement, France).
Proceedings of the 11th International Conference on Heavy Metals in the Environment, 6-10 August 2000, Ann Arbor, MI.
University of Michigan, School of Public Health, Paper No 1105, CD-ROM, 2000.

The behavior and fate of mercury in the environment are closely related to its ambient speciation. Several analytical approaches have been developed to determine mercury species in different ecosystem compartments. For gas-phase samples, mercury species are concentrated on chromatographic phases and desorbed in a cryotrapping/separating (CT-GC) unit coupled to a detector. For water samples, the mercury species are determined with a field cryofocusing device using flow injection and hydride generation. For environmental solid samples, mercury species are detected by an on-line D-CT-GC-QFAAS system after sample preparation by a microwave-assisted technique. The proposed approaches based on the hyphenation technique by means of flow analysis meet the need of environmental investigation in terms of rapid and accurate analysis and field operation, as this paper illustrates with cases of successful applications of the method to estuarine environmental matrices for investigating the occurrences and fates of Hg.

Ethanol Detection Strategy with Multiple Digital Filtering of Passive FT-IR Interferograms
Idwasi, P.O. (Ohio Univ., Athens. Dept. of Chemistry); G.W. Small; R.J. Combs; R.B. Knapp; R.T. Kroutil.
Report No: ECBC-TR-209, NTIS: ADA396011. 37 pp, Sep 2001

Digital filtering methods are evaluated for automated detection of ethanol using passive Fourier transform infrared (FTIR) data collected during laboratory and open-air experiments. In applications where ethanol signals are overlapped by spectral interference signals (e.g., ammonia and acetone), the use of multiple digital filters is found to improve the sensitivity of the vapor analyte detection. The detection strategy applies bandpass digital filters to short interferogram segments that are acquired from the passive FTIR spectrometer configuration. To implement the automated detection of the ethanol target analyte, the filtered interferogram segments are input into a piece-wise linear discriminant analysis. Through the use of a set of training data, discriminants are computed that are subsequently used for automated detection of ethanol vapor. A two-filter strategy with separate ethanol and ammonia filters is compared to a single ethanol filter approach. Bandpass parameters of the digital filters and the interferogram segment location are optimized with laboratory data. Laboratory data are generated for ethanol, ammonia, and acetone vapor mixtures in a gas cell, whose contents are viewed against various infrared background radiances. The optimized parameters from the laboratory data are subsequently tested with open-air remote sensing data. The open-air data consist of elevated temperature ethanol and ammonia plumes generated from a portable emission stack. The two-filter strategy outperforms the single-filter approach in laboratory and open-air scenarios, where the ammonia spectral interference dominates the ethanol spectral signature.
The full text of this report is available in PDF through the DTIC search engine at http://stinet.dtic.mil/str/tr_fields.html

Evaluation of a New Personal Monitor Employing an Electrochemical Sensor for Measuring Hydrogen Peroxide in Air
Park, J., and M. Plese, Abbott Laboratories, North Chicago, IL; M. Puskar, Abbott Laboratories, Abbott Park, IL.
American Industrial Hygiene Conference & Exposition, 2-7 June 2001, New Orleans, Louisiana. #128

The authors evaluated a commercially available direct-reading instrument designed for personal monitoring of vapor phase hydrogen peroxide (VHP). The current OSHA method for VHP measurement is based on bubbling in acid solution with subsequent laboratory analysis, which is inconvenient for personal monitoring. An instrument with an electrochemical sensor provides real-time exposure data with practical functions, such as displaying concentration in ppm, data logging, and alarms. The overall accuracy of the instrument was well within ± 25%, or the NIOSH criterion. The instrument responded to and recovered from 6 ppm in less than 30 seconds.

Evaluation of Chemical Protective Clothing by FT-IR/ATR Spectroscopy
O'Callaghan, K.; P.M. Fredericks; D. Bromwich, Centre for Instrumental & Developmental Chemistry, Queensland Univ. of Technology, Brisbane, Queensland, Australia.
Applied Spectroscopy, Vol 55 No 5, May 2001

An attenuated total reflectance (ATR) permeation cell was used to evaluate the permeation of polymer samples from chemical protective clothing, mainly gloves, by a solvent, a commercial pesticide mix, and a volatile solid. The use of low gas pressure ensured good contact between sample and ATR crystal. The passage of the chemicals through the clothing sample could be followed by analysis of sets of FTIR spectra measured during permeation experiments, though diffusion coefficients could only be estimated. The ATR method is discussed and compared with the traditional two-compartment cell used for evaluation of chemical protective clothing.

Feasibility of THz Remote Sensing for DoD Applications
De Lucia, Frank C., Ohio State Univ. Research Foundation, Columbus.
NTIS: ADA385595. 20 pp, Oct 2000

This project was designed to identify applications of tetraherz (THz) frequency technology of potential interest to DoD and to provide a technical introduction for DARPA personnel to the underlying scientific and technical issues. The report begins with a discussion of the physics that governs the interactions between radiation and matter in the THz, with emphasis on the differences between low pressure gases, atmospheric pressure gases, and solids. Atmospheric propagation is considered as an example. Two other specific applications were developed in more detail. The first is a concept for a point detector of gases, which is based on the absolute specificity of rotational spectra in the THz. The second is a remote detection scheme that makes use of THz/IR double resonance. The former is based on well-understood science. The risks for the development of such a program lie in trade-offs against alternative solutions as a function of scenario.
The full text of this report is available in PDF through the DTIC search engine at http://stinet.dtic.mil/str/tr_fields.html

Fiber-Optic System for 77 K Phosphorescence Lifetime Measurements of Polycylic Aromatic Compounds in Shpol'skii Matrices
Martin, Travis L.; Andres D. Campiglia, Dept. of Chemistry, North Dakota State Univ., Fargo, ND.
Applied Spectroscopy, Vol 55 No 9, Sep 2001

A fiber-optic system for rapid, accurate, and precise 77 K measurements of relatively long phosphorescence lifetimes (tp = 200 ms) employs stimulated Raman scattering in connection with a pulsed laser source for sample excitation. Phosphorescence decay waveforms are collected at maximum emission wavelengths with a single channel detection system supported by a Lab-View based in-house program acting as a data acquisition instrument, data storage device, and data interpreter. The simplicity of the experimental procedure, the rather large tp differences observed from compounds within the same pollutant class, and the analytical figures of merit provide a solid foundation for pursuing low-temperature phosphorescence, time-resolved low-temperature phosphorescence, and low-temperature multidimensional luminescence analysis.

Field Application of the SL Luminoscope for Pollution Monitoring
Hyfantis, G.J. Jr., BioChem Tech., Inc.
Water, Ground, and Air Pollution Monitoring and Remediation, 6-7 November 2000.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 4199, p 115-123, 2001

The Synchronous Scanning Luminoscope (SSL) is a field-portable, synchronous luminescence spectrofluorometer developed for on-site analysis of contaminated soil and ground water. The SSL is capable of quantitative analysis of total polynuclear aromatic hydrocarbons (PAHs) at the parts per billion range using phosphorescence and fluorescence techniques, as well as generating benzo(a)pyrene equivalency results, based on seven carcinogenic PAHs and Navy risk numbers. The field measurements show a high correlation to laboratory data.

Field Applications of a Portable Luminoscope for Hazardous Screening
Hyfantis, George J. (Environmental Systems Corp.); Wendi Watts; Timothy P. Finnegan.
Environmental Monitoring and Remediation Technologies.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 3534, p 92-99, 1999

The Synchronous Scanning Luminoscope (SSL) is a field-portable, synchronous luminescence spectrofluorometer developed for on-site analysis of contaminated soil and ground water. Synchronous fluorescence can reduce the complexity of the fluorescence spectra and allow rapid field assessments. The SSL is capable of quantitative analysis of polyaromatic hydrocarbons (PAHs), creosotes, and polychlorinated biphenyls (PCBs) in complex mixtures.

Final Report: Low-Level Speciation of Cyanide in Waters
Wallschläger, Dirk (PI), Frontier Geosciences, Inc.
EPA SBIR Grant No 68D01023, Apr 2001 - Sep 2001

Methods for the determination of cyanide speciation are needed for proper investigation. Unfortunately, existing methods, especially those approved by regulators, only measure "total" cyanide, or the sum of the labile cyanide species commonly known as "WAD" (weak acid-dissociable) cyanide. This leads to an overestimation of the (eco)toxicological threat and prevents detailed knowledge of the fate of cyanide in technical processes, including waste treatment streams. U.S. water

quality criteria for cyanide are expressed as "free" cyanide, but currently available analytical methods cannot measure CN- specifically and independent of all other cyanide species. Regulators tend to adopt these values for groundwater criteria and industrial discharge permits, but—instead of using a common standard—define them as either "free," "WAD," or "total" cyanide. Additionally, EPA-approved methods for the determination of WAD cyanide (and total cyanide) typically are not sensitive enough in routine operation to yield reliable analytical results in the low µg L^{-1} concentration range. Consequently, industries frequently find themselves in situations where regulations require them to achieve cyanide discharge concentrations at levels that cannot be measured reliably. In this project, Frontier Geosciences, Inc., developed a prototype analytical method for the separation and determination of several relevant forms of cyanide ("species") in waters by ion chromatography-anion self-regenerating suppression-conductivity detection-flow injection-gas diffusion-amperometric detection (IC-ASRS-CD-FIGDAD).
http://es.epa.gov/ncer/final/sbir/01/monitor/wallschlager.html

The Flow-Injection Spectroscopic Speciation of Aluminum, Mercury, Selenium and Sulfur
Palmer, Christopher David, Ph.D. dissertation, Univ. of Massachusetts at Amherst.
University Microfilm, UMI Pub No AAT 3000330. ISBN: 0-493-08394-4. 2001, 173 pages

This dissertation describes the development and evaluation of some new procedures for the determination of various chemical forms of aluminum, mercury, selenium, and sulfur. Studies of the biological and environmental transformations of elements are underpinned by the provision of reliable information about the relative concentrations of various chemical forms of the elements. The final measurements were made by graphite furnace atomic absorption spectrometry (GFAAS), cold vapor atomic absorption spectrometry (CVAAS), molecular emission spectrometry (MES), and atomic fluorescence spectrometry (AFS). These measurement techniques were preceded by selective chemical reactions based on liquid-liquid extraction (LLE), chemical vapor generation (CVG) [in particular, hydride generation (HG)] and selective redox chemistry. For the selenium and sulfur speciation techniques, the atomic fluorescence instrument was adapted to monitor molecular sulfur emission and selenium fluorescence simultaneously through two of the instrument's channels. The analyte elements in a sodium tetrahydroborate matrix were merged with a hydrochloric acid stream in a flow-injection manifold, chemical vapor generation was used to introduce the analytes into an argon-hydrogen diffusion flame in the form of hydrogen selenide and hydrogen sulfide. A speciation procedure was developed based on the reactivity towards borohydride at low acid concentrations and the amalgam trapping of both mercury and methylmercury hydride. Spectroscopic discrimination between the methylmercury and inorganic mercury was made by using an amalgam trap. When the amalgam trap was bypassed, no signal for methylmercury was observed. This method was applied to the determination of inorganic and methylmercury in river water tap water, and urine matrices. Validation was performed by analysis of the standard reference materials TORT-2, DOLT-2 and DOMR-2 CRMs. An automated flow-injection approach for the speciation of aqueous aluminum species in waters is suggested. It is intended that the flow-injection manifold be used to identify three types of aluminum: acid reactive (Alr), labile monomeric (Ala), and nonlabile monomeric (Alo). Initial results have been obtained for flow-injection liquid-liquid extraction interfaced with GF-AAS.

Fluorescent Fiber-Optic Sensor Arrays Probed Utilizing Evanescent Fiber-Fiber Coupling
Prince, Barry J.; Nadejda T. Kaltcheva; Alan W. Schwabacher; Peter Geissinger, Dept. of Chemistry, Univ. of Wisconsin-Milwaukee.
Applied Spectroscopy, Vol 55 No 8, Aug 2001

The interrogation of a fluorophore with a short laser pulse propagating through the fiber core allows for the measurement of the location of the fluorophore by measuring the time delay between the exciting pulse and the returning fluorescence pulse. A minimum separation of the fluorophores is required to resolve returning light pulses, which limits the spatial resolution of such an array of fluorescent sensors. A closer spacing of sensor regions is desirable for many applications, particularly for fibers prepared using the one-dimensional combinatorial chemistry method, which allows for efficient preparation of large, diverse, and densely packed linear arrays of sensors. By using a second fiber as an optical delay line, the minimum spacing between adjacent sensor regions can be well below the fluorescence lifetime limit. Because the coupling between the two fibers is evanescent, the attenuation of the excitation pulse is low, making long arrays of sensor regions feasible.

Frequency Agile Laser (FAL) Lidar Trigger and Signal Simulator Test Set
Moon, Raphael P., Edgewood Chemical Biological Center, Aberdeen Proving Ground, MD.
Report No: ECBC-TR-095, DTIC Order No: ADA380318. 39 pp, Jul 2001

Frequency Agile CO2 laser (FAL) is a laser-based standoff chemical sensor developed by Hughes Aircraft Company for ECBC. This document describes detailed design of the FAL LIDAR trigger and signal simulator test set. The test set provides burst trigger pulses, 12 laser trigger pulses, and 15 unique LIDAR return signals at 1 km. One return signal output provides peak signal amplitudes of 18 mV to 1.8 V, and the second provides output of 54 mV to 5.4 V. This test set eliminates the need for operating the laser during hardware and software evaluation of the data acquisition system.

The full text of this report is available in PDF through the DTIC search engine at http://stinet.dtic.mil/str/tr_fields.html

Gas Microsensor Based on Photocatalytic TiO2 Films
Skubal, L.R. (Argonne National Lab. and Pennsylvania State Univ.); M.C. Vogt (Argonne National Lab.).
Water, Ground, and Air Pollution Monitoring and Remediation, 6-7 November 2000.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 4199, p 157-164, 2001

In the study described here, titanium dioxide (TiO2) sensors were produced and tested at ambient temperatures in a controlled atmospheric cell. The sensors were exposed to a variety of organic compounds in the presence of ultraviolet light, and electrical responses from the TiO2 sensors were monitored. As the sensors reacted with specific gaseous organics, unique voltammetric signatures were obtained that could be used to distinguish and identify gaseous constituents.

A Generic Microfluidic System for Remote Sensors
Ahn, Chong H. (Cincinnati Univ., OH); H.T. Henderson; W.R. Heineman; J.H. Nevin; A.J. Helmicki.
DTIC Order No: ADA394027. 72 pp, May 2001

The objective of this project is to develop a generic MEMS-based microfluidic system for portable biochemical detection systems. To achieve this goal, an innovative generic MEMS-based microfluidic system has been designed, fabricated, characterized, and successfully applied to a portable all-in-one biochemical detection system. The analytical concept is based on an immunoassay with electrochemical detection. Microbead technology is adopted for both sampling and detection to trap and manipulate the target. Through the project, a portable integrated biochemical detection system has been successfully developed and characterized for the sampling and detection of 50 ng/ml of antigen concentration in 20 minutes of total assay time.

The full text of this report is available in PDF through the DTIC search engine at http://stinet.dtic.mil/str/tr_fields.html

Geoelectrical Signatures of NAPL Impacted Soils: Implications for the Monitoring of Natural Attenuation
Atekwana, Estella (Univ. of Missouri, Rolla); W.A. Sauck (Western Michigan Univ., Kalamazoo).
Association of Engineering Geologists & American Institute of Professional Geologists 2001 Joint Annual Meeting Abstracts. AEG News, Vol 44 No 4, p 54, Jul 2001

The basis for applying geophysical methods to the detection of subsurface contamination by non-aqueous phase liquids (NAPLs) is the contrasting electrical properties of NAPLs vs. pore and ground water displaced by NAPL free-product pools. Because NAILS have conductivities and dielectric permittivities that are low when compared with water, the current "insulating layer model" for NAPL contamination predicts that NAILS will be detectable as zones of anomalously low electrical conductivity (high resistivity) and dielectric permittivity within the subsurface, which forms the basis for the interpretation of geophysical data from NAPL impacted sites. This study provides evidence from both field and laboratory investigations linking microbial NAPL degradation to changes in the geophysical response observed at many NAPL-impacted sites. The researchers conclude that the potential for the use of geophysical methods as a proxy for natural attenuation is high. Significant cost savings and risk reduction should be realized with the integration of geophysical techniques as part of remediation schemes.

Geophysical Characterization of a Former Industrial Property, Chicago, Illinois
Calhoun, Bridget L.; John L. Petruccione; Theodore D. Bushell, STS Consultants, Ltd., Vernon Hills, IL.
Association of Engineering Geologists & American Institute of Professional Geologists 2001 Joint Annual Meeting Abstracts. AEG News, Vol 44 No 4, p 57, Jul 2001

To illustrate the application of geophysical surveying techniques during an initial site reconnaissance, the authors present an analysis of a non-destructive geophysical investigation performed at the U.S. Steel-South Works property in Chicago, Illinois, in the autumn of 1999. High-definition (5 x 5 ft coverage) time- and frequency-domain electromagnetic surveying was employed across the 118-acre survey area to map buried structures related to former site operations. Results were compared to historic site maps and aerial photos, revealing a remarkable similarity between previous site structures and the interpreted foundation walls, reinforced slabs, footings, sheet piles, railroad tracks, and utilities that remained after plant decommissioning. More than 60 test pits were also completed at interpreted geophysical anomalies to verify their source.

A Geostatistical Approach for Selecting Long-Term Monitoring Well Locations from Direct-Push Field Screening Data
Varljen, Mark D., SCS Engineers, Inc., Bellevue, WA.
Association of Engineering Geologists & American Institute of Professional Geologists 2001 Joint Annual Meeting Abstracts. AEG News, Vol 44 No 4, p 78, Jul 2001

In practice, direct-push sampling results can be "noisy," largely due to the fact that well points are not developed and sampled with the care that is normally exercised with monitoring wells. To address the problem, a geostatistical technique called indicator kriging can be applied to field screening data to render the interpolation and mapping process more robust, producing a map that represents the conditional probability at any location that ground-water contamination will be encountered if a well were installed and sampled. Having access to probabilities allows for more informed decision- making concerning the location of permanent monitoring wells. A case study illustrates this approach at a petroleum hydrocarbon-contaminated site where 20 HydroPunch samples were collected and analyzed in the field using immunoassay techniques. Conventional contour maps could not be prepared from the data; however, the indicator kriging approach provided a confident means to assess plume geometry and identify locations for permanent monitoring well locations.

Hand-Held NIR Spectrometry: Part I. An Instrument Based upon Gap-Second Derivative Theory
Morimoto, S.; W.F. McClure; D.L. Stanfield, North Carolina State Univ., Raleigh.
Applied Spectroscopy, Vol 55 No 2, Feb 2001

This paper describes the design, construction, and performance testing of a hand-held NIR meter based upon gap-2nd derivative (GSD) theory and called the Gmeter. The design incorporates narrow-band interference filters for isolating the three wavelengths required by the GSD calculations. A microprocessor facilitates both stand-alone and PC operation. Performance of the caddy-mounted Gmeter was compared with the performance of a FOSS NIRSystems Model 6500 spectrophotometer for measuring protein in soy-protein/sugar mixtures and for measuring nitrogen in Fescue grass tissue.

Handheld Laser-Based Sensor for Remote Detection of Toxic and Hazardous Gases
Frish, Michael B. (Physical Sciences, Inc., Andover, MA); M.A. White; M.G. Allen.
Water, Ground, and Air Pollution Monitoring and Remediation.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 4199, p 19-28, 2001

This paper describes the demonstration of a new optical tool designed to help petrochemical refinery and chemical processing plant personnel locate the source of a toxic or hazardous gas leak while remaining outside the perimeter of the processing area. Based on Tunable Diode Laser Absorption Spectroscopy (TDLAS), this hand-held sensor is capable of locating leaks from a distance of about 20 m, with a response time of less than 1 second. The sensor combines a lightweight, portable optical transceiver with battery-operated electronics in a single hand-held package that can be configured to sense leaks at path-integrated concentrations, such as 2 ppm-m of hydrogen fluoride, 200 ppm-m of hydrogen sulfide, or 10 ppm-m of methane.

High Resolution Two-Dimensional Electrical Imaging Surveys
Leberfinger, Jeffrey L. (American Technologies, Inc., Hershey, PA); Amy L. Bruggeman (ARM Group, Inc., Hershey, PA).
Association of Engineering Geologists & American Institute of Professional Geologists 2001 Joint Annual Meeting Abstracts. AEG News, Vol 44 No 4, p 67, Jul 2001

High-resolution electrical imaging data can be acquired by overlapping data levels and offset electrode spacings. The overlapping data method can improve data quality, especially in noisy areas. The offset electrode method can provide higher resolution for both horizontal and vertical data. In a two-dimensional imaging survey performed over an area where karst-related sinkhole features had formed in the past, the data were collected using standard- and high-resolution imaging techniques. The results from high-resolution surveys were compared to results from surveys using standard collection methods.

Hyperspectral Imaging Sensor with Real-Time Processor Performing Principle Components Analyses for Gas Detection
Hinnrichs, Michele, Pacific Advanced Technology, Santa Ynez, CA.
NTIS: ADA392947, 15 pp, Mar 2000

Chemical warfare agents in the gas phase are a considerable threat from terrorists. The ability to detect, identify and determine the direction of propagation of such gases is of considerable interest to the armed forces. With support from the U.S. Air Force and Navy, Pacific Advanced Technology has developed a small man-portable hyperspectral imaging sensor with an embedded DSP processor for real-time processing that is capable of remotely imaging gas plumes. Based upon their spectral signature, species and concentration levels can be determined. This system has been field tested at numerous places including White Mountain, CA, Edwards AFB, and Vandenberg AFB. Recently, evaluation of the system for gas detection has been performed. This paper presents these results.

Identification of Chemical Structures from Infrared Spectra by Using Neural Networks
Tanabe, K.; T. Matsumoto; et al., National Inst. of Advanced Industrial Science and Technology, Tsukuba, Ibaraki, Japan.
Applied Spectroscopy, Vol 55 No 10, Oct 2001

Researchers have evaluated the performance of a neural network system to identify chemical structures from infrared spectra. Neural networks for identifying over 100 functional groups have been trained with over 10,000 infrared spectral data compiled in an integrated spectral database system. Various types of functional groups can be identified with neural networks with an average accuracy of about 80%. The authors discuss why 100% identification accuracy has not yet been achieved.

Imagery Spectroscopy Application for Super Fund Mining Waste Monitoring
Roper, William E., George Washington Univ.
Geo-Spatial Image and Data Exploitation II.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 4383, p 1-11, 2001

The AVIRIS hyper-spectral remote sensing system developed by the Jet Propulsion Laboratory was used to collect the imagery data used to examine iron oxide acid mine drainage contamination at two Superfund sites located in Leadville, Colorado, and New Mexico (the Ray Mine site). Image spectroscopy was evaluated at these two sites for identifying potential mineral pollutants and mapping their location for cleanup planning and monitoring applications, with results indicating that the technology can be a very useful tool for this type of application.

The Impact of Copper on Soil Bacteria in the Field As Determined by a Copper-Specific Pseudomonas Biosensor and by a Terminal Restriction Fragment Length Polymorphism (T-RFLP) Diversity Assay
Tom-Petersen, Andreas; Thomas Leser; Ole Nybroe, State Veterinary Lab., Copenhagen, Denmark and Dept. of Ecology, Royal Veterinary and Agricultural Univ., Frederiksberg, Denmark.
MAREP: Marker/Reporter Genes in Microbial Ecology, Second International Conference, 4-7 December 1999, Stockholm, Sweden. Book of Abstracts, [poster presentation] p 39, 1999

To determine the impact of copper (Cu) on the soil bacterial community under field conditions, experimental plots on a barley field were amended with CuSO4 (0-65 g Cu/m^2). Soil samples was collected from each plot 8 months later. Bioavailable Cu was measured with a Cu-specific *Pseudomonas fluorescens* reporter strain, DF57-Cu15. The strain carries a Tn5::luxAB gene cassette regulated by an indigenous chromosomal Cu-induced promoter. Another mutant strain, DF57-40E7, with a stable emission of bioluminescence was used as a control for inhibition of the light emission. The reporter constructs were either mixed directly with the soil or exposed to soil extracts. The results show an agreement between the amended Cu-concentrations and amount of bioavailable Cu in the soils. The soils with the highest Cu amendments were inhibitory for the reporter bacteria. The structure of the soil bacterial community was examined by Terminal Restriction Fragment Length Polymorphism (T-RFLP) analysis. Total DNA was extracted from sieved soil and PCR amplified with a set of primers that were specific for eubacterial 16S rDNA. The forward primer was labeled with a fluochrome. The PCR product was digested with HhaI and analyzed by gel electrophoresis in an automated DNA sequencer recording the migration of the labeled terminal restriction fragments. The T-RFLP profiles from Cu amended and non-amended soils were similar, even in samples where the biosensor detected inhibitory Cu concentrations. However, if the soil samples were incubated as water slurries in the laboratory prior to DNA extraction, a few distinct differences in the profiles from amended and non-amended soil appeared.
Book of abstracts available at http://www.sh.se/marep/congr2test.html

In Situ Determination of Arsenic and Other Toxic Trace Elements by Laser Ablation ICP-MS
Ridley, W.Ian, USGS, Denver, CO.
USGS Workshop on Arsenic in the Environment, 21-22 February 2001, Denver, CO

Abstract not available.

Inductively Coupled Plasma Mass Spectrometry and Inductively Coupled Plasma Atomic Emission Spectroscopy Used in the Determination and Speciation of Trace Elements
Ponce de Leon-Hill, Claudia Alejandra, Ph.D. dissertation, Univ. of Cincinnati.
University Microfilm, UMI Pub No AAT 3014173. ISBN: 0-493-24124-8. 119 pp, 2001

A factorial design was used for a slurry preparation in the determination of five different elements with ICP-AES determination. The study included a chiral separation of nine selenoaminoacids using a crown ether HPLC column coupled to ICP-MS for detection. Three different temperatures were investigated for the separation of the enantiomers of individual amino acids and for a mixture of eight selenoamino acids. Although complete resolution was not achieved, better resolution of the mixture was obtained at higher temperatures. Selenium-enriched onion, garlic, and yeast were also analyzed. Two different extraction methods for the samples are compared, and some of the selenoamino acid enantiomers are identified. Comparison is also made with earlier reported separations for some of these selenoamino acids. Several procedures to perform selenium enrichment of yeast have been evaluated in the present work in terms of yeast cell growth protocols, total selenium accumulation, and to a limited degree, selenium species formation. Four enrichment procedures have been evaluated using sodium selenite as the selenium source: (a) enrichment during the growth phase, (b) enrichment at the non-growth phase (both of these at different selenium levels); (c) enrichment by seeding in a fermentable carbon source (glucose); and (d) enrichment by using non-fermentable carbon source (glycerol). A nitric acid digestion of the yeast has been performed in order to evaluate the total selenium incorporated into the yeast cells.

Industrial Stack Evaluation Using a Ground-Based Passive 3 to 5 Micron Fourier Transform Infrared Spectrometer

Combs, Roger J.; Robert B. Knapp; Robert T. Kroutil, Edgewood Chemical Biological Center, Aberdeen Proving Ground, MD.

Report No: ECBC-TR-182, NTIS: ADA391901. 194 pp, May 2001

This report documents the approach for obtaining absorbance and transmittance spectra using a passive 3- to 5-micron Fourier transform infrared (FTIR) spectrometer from two industrial stacks. Independent knowledge of the stack plume temperature is key to generation of the single beam spectral ratio of differences that allows removal of instrumental effects from the absorbance and transmittance spectra. The empirical results are illustrated for two types of industrial stack in the form of summary graphs and tables. Appendixes in this report supply representative spectral data acquired with the 3- to 5-micron passive FTIR spectrometer. Target plume constituents of sulfur dioxide, carbon dioxide, and nitrous oxide are discussed.
The full text of this report is available in PDF through the DTIC search engine at http://stinet.dtic.mil/str/tr_fields.html

Influence of Wavelength Selection and Data Preprocessing on Near-Infrared Based Classification of Demolition Waste

de Groot, P.J.; G.J. Postma; W.J. Melssen; L.M.C. Buydens, Lab. for Analytical Chemistry, Univ. of Nijmegen, Toernooiveld, Nijmegen, The Netherlands.

Applied Spectroscopy, Vol 55 No 2, Feb 2001

Demolition waste separated in three fractions—wood (required purity > 90%), plastic (required purity > 80%), and stone (no requirement)—were measured with diffuse near-infrared reflectance spectroscopy and classified with linear discriminant analysis. Several preprocessing techniques were investigated to improve the classification results, and to speed up the classification, simulated annealing extracted the six most discriminating wavelength regions for each preprocessing technique. Both the reflectance R and log10(l/R) are investigated. SNV preprocessing modified by the addition of the mean spectral value after applying standard SNV preprocessing and applied on the reflectance R was shown to be the best preprocessing technique.

Infrared Detection of Volatile Compounds from Microorganisms

Burggraf, L.W. (Air Force Inst. of Technology); C.A. Bleckmann; G. Li; C.J. Leonard; H.L. Mitchell; J.R. Reynolds; D. Eastwood.

Chemical and Biological Sensing.

Proceedings of SPIE--The International Society for Optical Engineering, Vol 4036, p 163-168, 2000

In a study to examine the proposition that the volatile compounds produced by microorganisms might be used to quickly distinguish microorganism types, the researchers measured infrared spectra of volatiles given off by common soil microorganisms using a Fourier transform infrared spectrophotometer. Spectral signatures of cultures dominated by coccus microorganisms differed from those with bacillus microorganisms, suggesting that with improved infrared detection, infrared signatures of microbial volatiles might be useful to characterize microbial consortia.

Infrared Spectral Classification with Artificial Neural Networks and Classical Pattern Recognition
Mayfield, Howard T. (Air Force Research Lab.); DeLyle Eastwood (Air Force Inst. of Technology); Larry W. Burggraf.
Chemical and Biological Sensing.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 4036, p 54-65, 2000

Computer-assisted classification tools, including pattern recognition and artificial neural network techniques, have been applied to a collection of infrared spectra of organophosphorus compounds. The computer tools have successfully discriminated commercial pesticide compounds from military nerve agents, precursors, and hydrolysis products. To test the classification tools further, additional infrared spectra from the NIST gas-phase infrared library were added to the data set for comparison to probe the tendency of the trained classifiers to misidentify unrelated spectra into the trained classes.

Initial Development of Continuous Emissions Monitor of Dioxin
Coggiola, Michael J.; Harald Oser; Gregory W. Faris; David R. Crosley, Molecular Physics Laboratory, SRI International, Menlo Park, CA.
Industry Partnerships for Environmental Science and Technology Conference, 2000.
U.S. DOE, National Energy Technology Laboratory. 8 pp, 2000

The need for a continuous emissions monitor for the determination of dioxins and furans at realistic (ppt or sub-ppt) concentrations in real time (minutes) is widely recognized in the waste combustion community. The key issues are overall sensitivity and selectivity among the many congeners found in real applications. SRI International is developing an instrument to meet these needs. The instrument is based on supersonic jet expansion and cooling, followed by resonantly enhanced multiphoton ionization (REMPI) into a mass spectrometer. This furnishes the dual selectivity of tuned laser absorption and mass analysis. SRI has developed an improved system design that optimizes ionization efficiency, based on a systematic study of the internal temperature of jet-cooled molecules subjected to REMPI in the instrument.
http://www.fetc.doe.gov/publications/proceedings/00/ind_part00/em6-2.pdf

Interference Filter Refinement for Artificial Nose Fluorescence Sensing
Karunamuni, J. (Lite Weaver Technologies); K.E. Stitzer (Univ. of South Carolina); D. Eastwood; K.J. Albert (Tufts Univ.); D.R. Walt; S.B. Brown (Lawrence Livermore National Lab.); M.L. Myrick (Univ. of South Carolina).
Optical Engineering, Vol 40 No 6, p 888-895, 2001

The authors outline a general method for designing optical filters for the optical train of a specific fluorescence sensor system, simultaneously using two light-emitting diode excitation sources (blue and green) and two different fluorescent indicators.

Intramolecularly Hydrogen-Bonded Polypyrroles as Electro-Optical Sensors
Nicholson, Jesse M. (Howard Univ., Washington, DC); S.K. Pollack; Y. Hijji.
DTIC Order No: ADA386691. 15 pp, Feb 2001

The researchers have developed a new class of polypyrroles bearing both hydrogen- bond acceptor and hydrogen-donor groups such that the intramolecular hydrogen bonding holds the system planar enhancing conjugation. The presence of other hydrogen-bond acceptors causes a disruption in this effect. Strong solvatochromic shifts occur to the blue in this case. As part of the attempt to improve on the synthesis of the monomer, microwave-assisted Diels-Alder reactions have been exploited to form the heterocyclic monomer.
The full text of this report is available in PDF through the DTIC search engine at http://stinet.dtic.mil/str/tr_fields.html

Investigation of Natural Fractionation of Stable Mercury Isotopes by Multi-Collector Inductively Coupled Plasma Mass Spectrometry
Klaue, Bjorn; Stephen E. Kesler; Joel D. Blum, Geological Sciences, Univ. of Michigan.
Proceedings of the 11th International Conference on Heavy Metals in the Environment, 6-10 August 2000, Ann Arbor, MI.
University of Michigan, School of Public Health, Paper No 1101, CD-ROM, 2000.

Although the analysis of the mercury isotopic pattern in environmental samples may offer new ways of source and pathway identification for Hg species, neither the true isotopic composition nor the fractionation of Hg isotopes has been studied in detail with modern instrumentation. Multi-collector inductively coupled plasma mass spectrometry (MC-ICPMS) allows analysis of the isotopic composition of Hg with a precision of better than 0.01%. The authors present the methodology, as well as preliminary data of Hg isotopic patterns in ore, coal, and environmental samples.

Investigation of Sequential Extractions Methods for Determination of Mercury Species in Sediments
Sladek, Chris; Mae Sexauer Gustin, Univ. of Nevada.
Proceedings of the 11th International Conference on Heavy Metals in the Environment, 6-10 August 2000, Ann Arbor, MI.
University of Michigan, School of Public Health, Paper No 1103, CD-ROM, 2000.

This project evaluated the efficiency of some procedures commonly used in sequential extraction methods for determining mercury speciation in sediments. Pyrolitic methods were applied for the determination of volatile phases, leaching with chloride solutions was utilized for determination of soluble or mobile species, and acid digestions were used to extract strongly bound or relatively immobile species, and for total mercury analyses. Pyrolitic extraction can sometimes greatly overestimate elemental mercury. Ammonium chloride was found to be more efficient than $MgCl2$ in removing soluble species. The organic content of a sediment was found to have a significant influence on sequential extraction results; inorganic amendments also influenced extraction results but not as strongly as organic matter.

Ion Mobility Spectrometry, Current Projects: Determination of Volatile Organic Hydrocarbons from Soils and Waters Through Ion Mobility Spectrometry
Inst. of Spectrochemistry and Applied Spectroscopy, Dortmund and Berlin, Germany, web site.

The diagnosis and assessment of the sanitary and environmental risks resulting from the presence, the mobility, and the fate of volatile organic compounds (VOCs) in contaminated soils, the subsurface, ground waters, or old landfills, need an accurate knowledge of their transport dynamics inside and between the several media of the natural environment. Results of field investigations of benzene, toluene, xylene, and other selected VOCs using a Multi-Capillary Column equipped Ion Mobility Spectrometer confirm that the instrument has a high discriminating power towards the several VOCs constituting complex contaminants. The method also provides relevant information directly usable in a transfer and risk assessment model.
For more information, visit http://ims.isas-dortmund.de/ims/

Ionic Diffusion Phenomena and Organic Polymer Addition in Thin Clay Films: Investigation of Electrokinetic Remediation and Heavy Metal Transport Mechanisms in Clay and the Construction of a Miniaturized Total Analysis System
Baker, J. Scott, Ph.D. dissertation, Loyola University of Chicago.
University Microfilm, UMI Pub No AAT 3001590. ISBN: 0-493-10189-6. 244 pp, 2001

This research work addresses two fundamental issues involving molecular transport phenomena in clay minerals. The majority of this dissertation describes studies of ionic diffusion through thin layer clay films and the effect of a range of organic polymer additions on that diffusion. The final section describes the development of a miniaturized electrokinetic remediation analysis cell and the investigation of ionic heavy metal transport mechanisms and subsurface remediation methodology. Both research projects contribute to the fundamental understanding of ionic material transport in soils. The movement (diffusive transport) of molecules through clay barriers used as landfill liners at municipal and other waste disposal sites has been implicated in pollution of ground waters, and the importance of clay-organic interactions in industrial practices and the possibility of producing materials with new or modified properties have attracted considerable attention to this field. A rapid determination (under 12 hours) of diffusion rates has been obtained by use of a unique fiber optic instrument based on absorption spectrometry. The system allows for a true sink-source experimental arrangement. This dissertation describes the validation of that fiber optic detection system for measuring diffusive transport of solutes in clays. The detection limit can be as low as parts per million for molecules with molar absorptivities larger than 10^4 in the LTV-visible range. The effect that organic polymer additions have on diffusion phenomena and the reasons for that effect have been described and a mathematical model and computer simulation of the system developed. The experimental data agree well with the computer model simulations, as well as with the data from an electrochemical system.

Issues Related to Solution Chemistry in Mercury Sampling Impingers
Linak, William P. (U.S. EPA, Research Triangle Park, NC), Jeffrey V. Ryan; Behrooz S. Ghorishi (ARCADES Geraghty & Miller, Inc., Research Triangle Park, NC); Jost O.L. Wendt (Dept. of Chemical and Environmental Engineering, Univ. of Arizona, Tucson).
Journal of the Air & Waste Management Association, Vol 51 No 5, May 2001

This paper examines the potential for liquid-phase chemistry to bias the partitioning of mercury species within combustion flue gases, suggests the chemical mechanism responsible, and offers a possible solution through modification of the impinger solutions by the addition of $Na_2S_2O_3$.

Laboratory Validation and Field Study of a Direct-read Monitoring System for Toluene Diisocyanate (TDI) Vapors in the Workplace
Chapman, K. (K&M Environmental, Inc., Virginia Beach, VA), G. Mihaylov , K. Kirollos; K. Booth (Bayer Corp., Pittsburgh, PA), B. Cummings.
American Industrial Hygiene Conference & Exposition, 2-7 June 2001, New Orleans, Louisiana. #130

TDI is a highly toxic contaminant classified by NIOSH as a potential occupational carcinogen. A TDI monitoring system consisting of a simple, diffusive, passive monitor (badge) and a color comparator has been developed. In the presence of 5 ppb/hr TDI, a red exclamation mark on a white background appears within a triangle. The intensity of the color developed is measured with a color comparator with 16 levels of resolution ranging from 2.5 to 700 ppb/hr. The field study was conducted comparing the performance of the TDI badge, a modified version of OSHA Method 42 and a portable paper tape monitor. The study consisted of 22 personal monitors and 21 area monitors. The TDI badge had a bias of 36% under all field conditions. The TDI badge had a mean bias of 16% and the paper tape monitor had a mean bias of -19% compared to the modified OSHA Method.

Laser-Based Ion Mobility Spectrometry as Analytical Tool for Soil Analysis
Roch, T.; J.I. Baumbach, Inst. of Spectrochemistry and Applied Spectroscopy, Dortmund and Berlin, Germany.
International Society for Ion Mobility Spectrometry, Vol 1, p 43-47, 1998

Apart from optical techniques, the detection of ions is highly suitable for the in situ analysis of contaminants in environmental compartments. Ion mobility spectrometry (IMS) with its small and rigid experimental equipment and ability to work under atmospheric pressure is well suited for the selective detection of ions under field conditions. The application of IMS in environmental analysis up to now has been restricted mainly to the analysis of more or less volatile contaminants. The researchers are developing a laser-based IMS technique, in which a laser (in the IR-spectral region, e.g., Nd:YAG, k = 1064 nm) will be used for the desorption of non-volatile substances and for the resonant multi-photon ionization (tuneable laser in the UV-spectral region, Nd:YAG with OPO and frequency doubling unit), to identify non-volatile contaminants, e.g., polycyclic aromatic compounds or petroleum products in soils.

Laser Fluorescence for the Detection of Oil Pollutants in the Environment
He, Yi (Beijing Inst. of Technology); Jixiang Yan; Jiaze Li; Jie Liu; Changqing Yu.
Instruments for Optics and Optoelectronic Inspection and Control.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 4223, p 19-22, 2000

A laboratory unit has been designed to detect and identify oil pollutants by means of a laser-induced fluorescence spectrum analyzer. A UV laser beam from third harmonics of the Nd:YAG laser is used to excite target oil. The multichannel detection system consists of a spectrometer, a scientific-grade gated ICCD camera, and a digital delay generator. A personal computer controls the whole system and processes data. The laser and the receiving system have been successfully tested on oil samples at a distance of 25 m, and the system has the capacity to detect at a greater distance.

Laser Induced Breakdown Spectroscopy for Semi-Quantitative Elemental Analysis in Soils and Marine Sediments
Barbini, R. (ENEA, Frascati, Italy), F. Colao, R. Fantoni, V. Lazic, A. Palucci; F. Capitelli (Univ. of Bari, Italy); H.J.L. van der Steen (Pupil Scientific, Amsterdam, The Netherlands).
The 4th EARSeL Workshop: Lidar Remote Sensing of Land and Sea, 16-17 June 2000, Dresden.

The Laser-Induced Breakdown Spectroscopy (LIBS) technique is based upon the analysis of the atomic emission lines generated close to the surface sample. The emission is observed once a laser pulse is focused on the surface, where the very high field intensity initiates an avalanche ionization of the sample elements, giving rise to the so-called breakdown effect. Spectral and time-resolved analysis of this emission can identify atomic species originally present at the sample surface. The method can be certified for analytical applications of interest in environmental monitoring, assuming that the surface composition is maintained in the plasma and that ablation processes can be modeled in an appropriate temporal window, assuming quasi-equilibrium conditions. A compact instrument, suitable for both laboratory and field operation, has been designed and tested, along with software appropriate for qualitative and semi-quantitative analysis of elements in different soil and sediment matrices. Calibration-free methods for tracing significant pollutant species are under development. Also discussed are improvements in laser-induced plasma modeling based on temperature and electron density measurements aimed at a quantitative determination of selected species.
Available at http://las.physik.uni-oldenburg.de/projekte/earsel/4th_workshop.html

Laser Induced Plasma Spectroscopy (LIPS) as an Efficient Method for Elemental Analysis of Environmental Samples
Kompitsas, M. (National Hellenic Research Foundation, Athens, Greece); F. Roubani-Kalanzopoulou (National Technical Univ. of Athens, Chem. Engineering Dept., Athens, Greece), I. Bassiotis, A. Diamantopoulou, A. Giannoudakos.
The 4th EARSeL Workshop: Lidar Remote Sensing of Land and Sea, 16-17 June 2000, Dresden.

Laser Induced Plasma Spectroscopy (LIPS) has proved to be a powerful laser-based analytical technique due to its simplicity and versatility. Practically any kind of sample can be analyzed with little or no preparation. This paper presents a LIPS apparatus consisting of a Nd:YAG laser beam focused on the sample surface, with a XY translator as the sample holder, and a UV fiber cable used to collect the plasma emission and transfer it to a spectrometer equipped with a gated optical multi-channel analyzer (OMA III system). This system allows both spatially and temporally resolved spectra to be recorded. A large number of elements encountered in environmental samples have been identified in the 250-700 nm region; the samples were either in the form of a mixture of their oxides or encapsulated in glass matrices. The quality of the spectra in dependence on the various experimental parameters has been studied to use these samples as references for elemental qualitative and quantitative determination of natural samples.
Available at http://las.physik.uni-oldenburg.de/projekte/earsel/4th_workshop.html

Laser Spectroscopic Sensing of Air Pollutants
Sigrist, M.W. (Swiss Federal Inst. of Technology); A.M. Bohren; I.G. Calasso; M. Naegel; A. Romann; M. Seiter.
The 13th Symposium and School on High-Resolution Molecular Spectroscopy.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 4063, p 17-25, 2000

The systems presented here for laser spectroscopy applications to air pollution monitoring are based on tunable narrowband infrared sources, including a conventional line-tunable CO_2 laser, a continuously tunable high-pressure CO_2 laser, an optical-parametric-oscillator-based difference-frequency (DFG) laser, and a diode-based DFG laser. These systems cover the mid-infrared wavelength range. System performance is illustrated with examples of trace gas monitoring and determination of molecular relaxation rate constants with the photothermal scheme. Detection limits corresponding to minimum concentrations in the ppb or even sub-ppb level can be achieved. These types of laser spectrometers offer ease of operation at room temperature, with neither sample preparation nor pretreatment required; portability; excellent sensitivity and selectivity; large dynamic range up to seven orders of magnitude; and good temporal resolution.

Laser Spectroscopy of Mineral Oils on the Water Surface
Patsayeva, S., and V. Yuzhakov (Moscow State Univ., Russia); V. Varlamov (Inst. of Ecology, Tallinn Pedagogical Univ., Estonia); R. Barbini, R. Fantoni, C. Frassanito, and A. Palucci (ENEA, Frascati, Italy).
The 4th EARSeL Workshop: Lidar Remote Sensing of Land and Sea, 16-17 June 2000, Dresden.

The spectral properties of oil films ranging from sub-micrometer thickness up to an optically thick layer on the water surface were studied under controlled laboratory conditions using LIDAR systems operating at excitation wavelengths of 308 and 355 nm. Measurements of the fluorescence lifetime were performed for different mineral oils. The decay time varied from 1 to 3.5 ns for crude oils, and from 3.5 to 8 ns for refined products. A blue shift of the maximum position of the emission spectra was observed for crude oils under fluorescence saturation conditions at 355 nm excitation. The value of the blue shift depends on the oil type, and the researchers suggest using this value for mineral oil characterization in remote sensing. The technique of oil spill quantification using water Raman signal suppression has been improved. The algorithm of film thickness estimation experimentally tested in this work involves the calculation of the amplitude ratio of two spectral components contributing to the water Raman spectrum. Thus, the influence of accidental factors affecting the integral Raman intensity is eliminated.
Available at http://las.physik.uni-oldenburg.de/projekte/earsel/4th_workshop.html

LasIR Near Infrared Laser Spectrometer
Ontario Centre For Environmental Technology Advancement (OCETA) Environmental Technology, Profiles Catalog Item # 07-012, Feb 2000

The Unisearch LasIR® is a tunable diode laser system that measures selected gaseous compounds in stack/duct emission and in ambient air. The analytical method is based on the absorption of laser radiation in the near infrared wavelength region, from 0.6-2.0 microns. The radiation is emitted from tunable GaAs diode lasers operated room temperature. In addition to gallium and arsenic, other elements such as indium, antimony, and phosphorous can be incorporated in the laser crystal. By proper selection and combination of these elements, lasers can be manufactured to match the wavelength where the target gases absorb the radiation. Changing the current can change the wavelength over a small spectral range (1 nm). This tunability makes it possible to scan across the full feature of the absorption line of the target molecule and the adjacent region where the target molecule does not absorb. There is little or no interference from other emitting or absorbing species in the spectral region, even in the complex process mixtures. Contact: Unisearch Associates Inc., Concord, Ontario, Canada, (905) 669-3547, info@unisearch-associates.com.
http://www.oceta.on.ca/profiles/unisearchl/lasir_tech.html

Limitations of Long-Path Averaging Instruments
Collins, Dave (Univ. of Melbourne, Parkville, Victoria, Australia).
Journal of the Air & Waste Management Association, Vol 50 No 10, p 1790-1797, Oct 2000

The purpose of this paper is to describe some of the limitations of long-path averaging instruments — i.e., measuring concentration in a single dimension and deriving an average concentration without considering velocity effects — and to suggest ways in which these limitations can be minimized. Where the concentration and velocity deviate significantly from the mean, the magnitude of this error was calculated to be 50% or greater for a range of possible profiles. These errors can be reduced to negligible levels by segmenting the path length into a number of shorter paths.

Liquid Flow Through Composite Liners Due to Geomembrane Defects: Analytical Solutions for Axi-Symmetric and Two-Dimensional Problems
Touze-Foltz, N.; R.K. Rowe; C. Duquennoi.
Geosynthetics International, Vol 6 No 6, p 455-479, 1999

A general framework for calculating the rate of liquid flow through a composite liner (geomembrane plus soil liner) with holes is presented. Solutions given for a circular hole and a damaged wrinkle can be used for interpreting data from laboratory tests, modeling expected field conditions, and interpreting field leakage data.

Lighting Up the Field of Bacterial Biosensors: Applications of *lux*-Marked Bacteria as Sensors of Environmental Pollution
Glover, L. Anne; Ken Killham, Univ. of Aberdeen, Aberdeen, Scotland.
MAREP International Conference on Marker/Reporter Genes in Microbial Ecology, 14-17 June 1997, Stockholm, Sweden. Extended Abstracts.

The use of bioluminescent microorganisms offers a simple means of monitoring metabolic inhibition by sensing potentially toxic elements (PTEs) through measurement of light response. The basis of this system is to introduce the genes for bioluminescence (luxCDABE) either into the chromosome or as a multicopy plasmid into a microbe that is typical of the environment to be measured. Under the control of a strong constitutive promoter, the lux genes are transcribed and translated, and the luciferase protein emits light according to the following reaction. Bioluminescence is a measure of the metabolic activity of the cell via the electron transport chain. It therefore follows that if the cell is exposed to any perturbation that disrupts the function of the electron transport chain, bioluminescence will decrease. The researchers have compared the response of a *Pseudomonas fluorescens-lux* biosensor with alternative measures of cell activity, such as dehydrogenase assays and cellular ATP measurement, and have shown that the *lux*-marked biosensor assays are both more sensitive and a great deal more rapid. This biosensor will supply information regarding the bioavailability of environmental pollutants. The biosensor assay itself is rapid (10 minutes) and the biosensor organism can be stored in freeze-dried format and revived as required. The environmental sample is added directly to the resuscitated biosensor, and the decrease in luminescence compared to a control sample. Thus, this type of assay can be carried out quickly and simply and is amenable to field use as well as laboratory experimentation. Extended abstracts available at http://www.sh.se/marep/program.html

Low Power Quantum-Cascade Laser Photoacoustic Spectrometer for Trace-Gas Monitoring
Nagele, M.; D. Hofstetter; J. Faist; M.W. Sigrist, Swiss National Science Foundation.
Digest of the 11th International Conference on Photoacoustic and Photothermal Phenomena (11th ICPPP), Kyoto, Japan, 25-29 June 2000, paper P10-08.

The development of a novel type of highly sensitive multipass resonant photoacoustic (PA) cell for trace-gas detection enables the use of new compact low-power laser sources such as quantum-cascade lasers (QCLs) because the effective power present in the cell is increased by a factor of ~20 compared to a one-pass arrangement. To on an existing mobile CO_2-laser photoacoustic (PA) spectrometer the researchers added a laser housing for pulsed QCLs. The capability and efficiency of the PA spectrometer has been demonstrated using QCLs as pump sources with tunable emission wavelengths. First measurements on CO_2, methanol vapor, and ammonia were done to characterize the performance of our QCL based system.

Low Range Differential Pressure (LRDP) Leak Detection Technology
Karr, Leslie (Naval Facilities Engineering Service Center, Port Hueneme, CA); Joseph W. Marcesa, Jr. (Vista Research, Inc., Sunnyvale, CA).
CERF, Environmental Technology Evaluation Center (EvTEC) web site, Jun 2001

Vista Research, Inc., and the Naval Facilities Engineering Service Center (NFESC) have developed the Low Range Differential Pressure (LRDP) leak detection system for early detection of leaks in bulk USTs. The LRDP system is a mass-based, leak detection and monitoring system that was developed to reliably detect small leaks in bulk USTs. If a tank is leaking, the LRDP system quantitatively measures the leak rate in gallons per hour. The LRDP system is designed to operate under a wide variety of site conditions and is not limited by geographic or climatic regions. The system is targeted for use in bulk fuel tanks over 50,000 gallons (190 cubic meters), which are usually field-constructed; however, the LRDP technology can also be used on smaller storage tanks. The key component of the LRDP system is a vertical reference tube that spans the full usable height of the tank and is filled and drained with the tank. The reference tube is used to provide the differential pressure between the tank and the tube when as little as 0.5 inches of difference exists, regardless of the tank size. After the contents of the tank have settled, the tube is isolated from the tank by closing a valve and a differential pressure gauge between the tank and tube will read zero. The level of the fuel in the reference tube assumes the level of fuel in the tank. The differential pressure sensor will detect very small level (pressure) changes between the fuel in the tube and the level in the tank. The sensor quantifies the fuel level changes if a leak occurs. EvTEC organized a Review Panel Workshop in November 1999 and produced a 24-page Workshop Report available at this site in a PDF file.
http://www.cerf.org/evtec/eval/lrdp.htm

Luminous Bacteria Are Doing the Job: Biocide Activity Test in Water
CheckLight, Nov 2001

Many different bacteria species may exist in industrial cooling and heating water systems, fuel storage tanks, pulp and paper slurries, and metal-working cooling fluids that cause plugging, fouling, underdeposit corrosion, and health hazards. Adding different kinds of biocides to the process water is a standard preventive measure. The CheckLight Biocide Activity Test is a quick and simple real-time test to quantitatively measure biocide activity on site to avoid problems caused by biocide overdosing. A simple three-step procedure can be performed under field conditions in ambient temperature (18-28°C). Only 1mL of sample is necessary to run the assay, making collection, storage, and disposal of sample material easy and cheap. CheckLight's proprietary-based kits use bioluminescent bacteria as biosensors. Toxicants such as fungicides, herbicides, chlorinated hydrocarbons, heavy metals, all dramatically affect the bacterial luminescence system. By comparing the luminescence level obtained in a suspected sample with that obtained from a clean water-control sample, users can detect very low concentrations of a broad range of pollutants. Cells are pre-treated so that once exposed to nutrients, luminescence is promptly induced and increases with time with an intensity dependent upon the concentration of the nutrient in the water sample. Contact: CheckLight Ltd., Qiryat Tiv'on, Israel, info@checklight.co.il.

Measuring Mass Depletion by Dissolution of Entrapped Nonaqueous-Phase Liquids in Fractured Media with X-Rays
McGahee, Joseph J.; Tissa Illangasekare, Colorado School of Mines, Golden, CO.
The 2000 Conference on Hazardous Waste Research: Environmental Challenges and Solutions to Resource Development, Production, and Use, 23-25 May 2000, Denver, Colorado
Great Plains/Rocky Mountain Hazardous Substance Research Center, Manhattan, KS.

At the Colorado School of Mines, x-rays will be used to measure the location and dissolution of NAILS in porous media. Better resolution and accuracy will be obtained in measurements compared to the use of gamma rays. Experiments will be performed to measure the dissolution of NAILS in fractured media, as well as various other experiments. The x-ray system will also be used in conjunction with the gamma system to better understand and determine the behavior of NAILS in porous media.
http://www.ecc.ksu.edu/HSRC/Abstracts00.html

Mercury CEMS: Technology Update
Ryan, Jeffrey V.; James D. Kilgroe, U.S. EPA, Research Triangle Park, NC.
Report No: EPA 600-A-01-036, 5 pp, 2001

The paper reviews the technologies involved with continuous emission monitors (CEMs) for mercury (Hg). Their potential use as a compliance assurance tool is of particular interest. While Hg CEMs are currently used in Europe for compliance purposes, use of Hg CEMs in the United States has focused on combustion research and Hg control technology evaluation applications. Hg CEMs are now receiving increased attention as compliance assurance tools. Several programs exist to evaluate Hg CEM measurement performance and advance the state of the art of the technology as evidenced by the number and types of CEMs now available and the various applications in use.
http://www.epa.gov/ORD/NRMRL/Pubs/2001/600a01036.htm

Mercury Species Determination in Organic Solution by Plasma Spectrometry
Snell, James Phillip, Ph.D. dissertation, Umea Universitet (Sweden).
[Not available from University Microfilm (UMI).] 27 pp, 2001

Species-specific mercury determination methods were developed using spectrometric techniques based on plasma source atomic emission or mass spectrometry. Elemental mercury, dimethylmercury, methylmercury, and inorganic mercury species were determined in hydrocarbon products, including natural gas condensate. A number of coupled systems for mercury speciation were developed and evaluated: gas chromatography (GC) post-column amalgamation trap-microwave induced plasma-atomic emission spectrometry (MIP-AES), GC-furnace atomisation plasma emission

spectrometry (FAPES), GC-inductively coupled plasma-mass spectrometry (ICP-MS), electrothermal vaporisation (ETV)-ICP-MS and GC-furnace atomisation plasma ionization/ mass spectrometry (FAPI-MS). Interferences on mercury detection on the introduction of hydrocarbon products, were identified and quantified for these systems. Reactions of mercury species in organic solutions were investigated to determine their influence on the stability of samples of hydrocarbon products, standards and reference materials. Redox proportionation and methylmercury symmetrisation reactions were observed. Derivatisation reactions with Grignard reagent for the preparation of mercury species for gas chromatographic, GC, separation were characterized. Evaluation of derivatisation efficiency and species transformation reactions allowed the adaption of methods to reduce errors on sample determination. Milligram-scale methods of synthesis were developed to produce standards of dimethylmercury, methylmercury chloride, and mercuric chloride, in organic solution, from isotopically enriched mercury. These standards were applied for species-specific isotope dilution calibration methods, and for recovery testing for GC-ICP-MS and GC-FAPI-MS systems. GC-FAPI-MS was also evaluated for use as a dual detector, producing molecular ions for species identification, as well as use as a sensitive atomic mass spectrometer.
http://www.chem.umu.se/jsl/snell_jp.pdf

Method and Instrumental Development for Ultra-Trace Elemental and Speciation Analysis
Han, Ye, Ph.D. dissertation, Duquesne Univ.
University Microfilm, UMI Pub No AAT 3016680. ISBN 0-493-27793-5. 210 pp, 2001,

This research has focused on method and instrument development for ultra-trace elemental analysis using microwave-enhanced clean chemistry. A novel dual-vessel design has been developed and has demonstrated an effective use of an efficient, controllable, and cost-effective sample preparation technique for the determination of ultra-trace impurities in silicon material. The technique further demonstrates the capability of the total retention of many traditionally volatile species at ultra-trace level by applying unique microwave heating and cooling mechanism. Second, new concepts of isotope dilution method have been investigated to improve long-term stability and to enhance threshold of the ultra-trace element at instrumental detection limit. These new concepts have been demonstrated using the instruments of Inductively Coupled Plasma Mass Spectrometry and Electro Spray Mass Spectrometry to determine ultra-trace elements over an extended period of time. A new threshold method using IDMS to enhance the quantitative capability of the MS instrument was also evaluated and established. The enhancements both near and at instrument detection limit were evidenced using Monte Carlo simulation. Portions of this study are patent pending. A sequential extraction method for mercury speciation in a soil matrix was established based on the mobility and toxicity of different mercury species. The most mobile and toxic mercury species, including alkyl mercury and soluble inorganic mercury species, were extracted using an acidic ethanol solution. The extracts could be further separated by the SCF-SPE-DMA-80 or by the HPLC-ICP-MS. The inorganic mercury remaining after the ethanol extraction could be further speciated by sequential acid extraction. The method is a promising candidate for on-site screening for mercury speciation and laboratory quantitation for mercury speciation, especially for ultra-trace alkyl mercury species.

A Method to Quantify Heavy Metal Polluted Soils with *lux*-Marked Soil Bacteria
Corbisier, P. (Vito, Environmental Technology, Mol, Belgium), D. Van Der Lelie; J. Vangronsveld (Limburgs Univ. Centrum, Diepenbeek, Belgium); L. Diels (Vito, Environmental Technology, Mol, Belgium).
MAREP: Marker/Reporter Genes in Microbial Ecology, Second International Conference, 4-7 December 1999, Stockholm, Sweden. Book of Abstracts, p 7, 1999

A bacterial sensor based on gene fusions between heavy metal inducible resistance operons of the soil bacterium *Alcaligenes eutrophus* CH34 and the *lux*CDABE operon of *Vibrio fischeri* allowed the detection of bioavailable concentrations of heavy metals in soils matrices. The response of five different sensors responding respectively to chromate, nickel, zinc, cadmium, and copper has been measured in naturally polluted soils and compared to other chemical and eco-toxicological assays. A large number of soil samples presenting different soil characteristics have been comparatively tested with the BIOMET bacterial sensors, with different plant and earthworms tests, and with conventional chemical analysis. In all cases, the bacterial sensors were able to deliver a rapid quantification of the fraction of metal that was biologically available to the soil bacteria. The inducibility of specific metal-induced enzymes in plants grown on the same soils, as well as metal accumulation in different plant compartments or the zootoxicity of earthworms, could be correlated with the quantity of metals measured with the bacterial sensors. This approach appeared to be very useful to quickly quantify the concentration of bioavailable heavy metal or to evaluate the efficacy of soil remediation techniques. Book of abstracts available at http://www.sh.se/marep/congr2test.html

Microelectronic Device and Method for Label-Free Detection and Quantification of Biological and Chemical Molecules
Tender, Leonard M. (Bethesda, MD); M. Peckerar (Silver Spring, MD); F.K. Perkins (Alexandria, VA); S.J. Fertig (Springfield, VA); E.S. Snow (Springfield, VA), Dept. of the Navy, Washington, DC.
Patent Application No: 09886051; DTIC Order No: ADD019944. 18 pp, 23 Jun 2000

This application describes a molecular recognition-based electronic sensor, which is gateless, with a depletion mode field effect transistor consisting of source and drain diffusions, a depletion-mode implant, and insulating layer chemically modified by immobilized molecular receptors that enables miniaturized label-free molecular detection amenable to high-density array formats. The conductivity of the active channel modulates current flow through the active channel when a voltage is applied between the source and drain diffusions. The conductivity of the active channel is determined by the potential of the sample solution in which the device is immersed and the device-solution interfacial capacitance. The conductivity of the active channel modulates current flow through the active channel when a voltage is applied between the source and drain diffusions. The interfacial capacitance is determined by the extent of occupancy of the immobilized receptor molecules by target molecules. Target molecules can be either charged or uncharged. Change in interfacial capacitance upon target molecule binding results in modulation of an externally supplied current through the channel.

Mobile Lidar System for Monitoring of Gaseous Pollutants in Atmosphere over Industrial and Urban Area
Moskalenko, I.V. (Russian Research Center, Kurchatov Inst., Moscow); D. Shecheglov; A.P. Rogachev (Research Inst. of Pulse Technique); A.A. Avdonin; N.A. Molodtsov (Design Bureau Salut).
Air Monitoring and Detection of Chemical and Biological Agents.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 3533, p 241-249, 1999

This paper describes the design, development and field testing of a mobile lidar system (MLS) based on utilization of differential absorption lidar (DIAL). The MLS system includes a narrowband transmitter, receiver, system steering, data acquisition subsystem, and software. The unit is housed in a mobile truck and is able to provide 3D mapping of gaseous species. Sulfur dioxide and elemental mercury were chosen as basic atmospheric pollutants to test the MLS in the field.

A Molecular Genetic Method for Monitoring Aerobic Bioremediation of Aromatic Hydrocarbons
Mesarch, Matthew Brian, Ph.D. dissertation, Purdue University.
University Microfilm, UMI Pub No AAT 3018246. ISBN: 0-493-29285-3. 126 pp, 2000

The purpose of this work was to determine whether a cultivation-independent approach could be used to monitor aerobic bioremediation of aromatic hydrocarbons. A cultivation-independent approach would be a significant improvement over standard cultivation-based methods, which are time intensive and are subject to several well-known biases. Catechol 2,3-dioxygenase genes were used as a marker for monitoring aerobic bioremediation because catechol 2,3-dioxygenase enzymes are involved in the biodegradation pathways of numerous environmentally significant aromatic compounds. Polymerase chain reaction (PCR) primers specific for catechol 2,3-dioxygenase genes were designed and tested on genetically well characterized strains of bacteria. A quantitative competitive PCR method was modified for use with these primers and evaluated in the presence of potential PCR inhibitors. Toluene, non-target DNA, and soil organic matter did not inhibit PCR. Use of this technique allowed detection of 10^2 to 10^3 genes. The detection limit was improved to 10^0 to 10^1 genes when a gene probe was used. Microcosm studies were performed to determine which aromatic compounds enriched for dioxygenase genes detectable with this method. Naphthalene, m-xylene, and p-xylene all enriched for detectable catechol 2,3-dioxygenase genes, while benzene, toluene, and o-xylene produced only transient, weakly detectable genes. In a field study catechol 2,3-dioxygenase genes were detected at a petroleum-contaminated site where an oxygen-releasing compound was being used to stimulate aerobic biodegradation. At a different petroleum-contaminated site where clay soils predominated, catechol 2,3-dioxygenase genes were generally not present. This is consistent with other data that indicate aerobic bioremediation of aromatic compounds was occurring at the site where the oxygen-releasing compound was being used, and was not occurring at the second field site. The results of this field study demonstrate that the molecular genetic method developed provides a more accurate and rapid detection of aromatic hydrocarbon-degraders than cultivation-based assays

Molecular Monitoring of Chloroethene-Dechlorinating Populations in a Pilot Scale Bioremediation Demonstration at the Bachman Road Site in Oscoda, MI
Dollhopf, E.; F.E. Loeffler; R. Helton; et al.
Proceedings of the Ninth International Symposium on Microbial Ecology, 26-31 August 2001, Amsterdam, The Netherlands. Paper No P.23.112, 2001

No abstract available.

Molecular Monitoring of Microbial Populations During Bioremediation of Contaminated Soils
Mills, DeEtta K., Ph.D. dissertation, George Mason Univ., Fairfax, VA. Fellow, U.S. EPA's Science to Achieve Results (STAR) Fellowship recipient.
University Microfilm, UMI Pub No AAT 9987991. ISBN: 0-599-95778-6. 217 pp, 2001

Molecular techniques have rapidly become valid methods for examining microbial communities in situ. Digesting nucleic acids with restriction endonucleases cuts DNA into different length fragments. Subsequent electrophoretic separation of the fragments will produce banding profiles (DNA fingerprints) that can be used to discriminate between populations. Variations of this restriction fragment length polymorphism (RFLP) method have successfully been used to monitor microbial community dynamics during bioremediation. The restriction fragment-based techniques (e.g., RFLP, T-RFLP) give some indication of the complexities of the communities but still underestimate the true diversity or dynamics of the microbial community. Amplicon length heterogeneity-PCR (LH-PCR) is a molecular technique that discriminates between different bacteria based on the natural sequence variations in the lengths of the 16S ribosomal DNA (rDNA) genes not on restriction enzyme recognition sites. Soils contaminated with petroleum hydrocarbons were treated in bench-scale bioreactors. Whole community DNA extracted from the bioreactor samples and the polymerase chain reaction (PCR) was used to amplify the 16S rDNA genes. The three DNA fingerprinting methods were compared to each other and to non-molecular techniques to ascertain which of the techniques could be used to monitor whole community dynamics. The LH-PCR method proved to be the most robust, reproducible and diagnostic of all the techniques tested. The LH-PCR technique was able to detect greater genetic diversity within the microbial communities. It also profiled significant differences in community structure between the bioreactor microbial communities undergoing different bioremediation treatment regimes. The LH-PCR technique has great potential as a monitoring tool that can significantly contribute to the basic understanding of the bioremediation processes.

Monitoring Biologically Available Mercury in Natural Samples Using a *mer-lux* Bioindicator
Sorensen, Soren J., Dept. General Microbiol. University of Copenhagen, Denmark.
MAREP International Conference on Marker/Reporter Genes in Microbial Ecology, 14-17 June 1997, Stockholm, Sweden. Extended Abstracts.

One of the problems in studying mercury in terrestrial ecosystems lies in the complexity of soil types and the reactive nature of the mercury ion (Hg2+), which may result in a difference between the level of mercury measured by the investigator and what is actually available for the microorganisms. This difference will vary greatly in different soils due to differences in composition of clay, silt, organic matter, etc. So far the bioavailable fraction of total mercury has been an unknown factor, due to the lack of measuring techniques, which makes it difficult to compare results obtained from different soils where the mercury concentration responsible for the observed effects is not known. The researchers have developed a method to quantify this bioavailable fraction by the use of a *mer-lux* bioindicator. The sensitivity of a previously described assay for the detection of bioavailable Hg2+ by the activation of a *mer-lux* fusion was increased from nM to pM, and the assay procedure was adapted for soil samples. The sensitivity of the *mer-lux* assay is now sufficient for the detection of Hg2+ in most contaminated natural environments.
Extended abstracts available at http://www.sh.se/marep/program.html

Monitoring of 4-Chlorophenol Degradation by *Arthrobacter chlorophenolicus* A6 in Soil Microcosms
Westerberg, Karolina (Stockholm Univ., Stockholm, Sweden), Anna Hman (Stockholm Univ., Stockholm, Sweden); Annelie Elv Ng (Stockholm Univ., Stockholm, Sweden); Cecilia Jernberg (Sodertorns hogskola, Huddinge, Sweden); Janet Jansson (Sodertorns hogskola, Huddinge, Sweden).
MAREP: Marker/Reporter Genes in Microbial Ecology, Second International Conference, 4-7 December 1999, Stockholm, Sweden. Book of Abstracts, [poster presentation] p 48, 1999

The environmental pollutant 4-chlorophenol is resistant to both chemical and biological degradation. The researchers have isolated a microorganism, strain A6, that is particularly efficient at degrading this compound. Taxonomic characterization of the isolate revealed that it was a novel species within the genus *Arthrobacter*, hence the proposed name *Arthrobacter chlorophenolicus*. The isolate appears to use an unusual 4-chlorophenol degradation pathway, with 1,2,4-benzene triol as a key intermediate. Work is currently in progress to clone genes encoding key enzymes in the process. *A. chlorophenolicus* A6 was chromosomally tagged with either the *luc* gene, encoding firefly luciferase, or the *gfp* gene, encoding green fluorescent protein. These strains were inoculated into soil microcosms artificially contaminated with 4-chlorophenol. The tagged A6 strains completely degraded the added

4-chlorophenol in 10 days, while 4-chlorophenol remained unchanged in uninoculated control microcosms during the same time period. The number of A6 cells in the microcosms as measured by plate counting decreased slightly during the course of degradation. The same trend was detected for the level of luminescence. On the other hand, the number of *gfp*-tagged cells remained at a higher level compared to the plate counts. Thus, cell number, cell activity, and 4-chlorophenol concentration could all be measured simultaneously in the microcosms.
Book of abstracts available at http://www.sh.se/marep/congr2test.html

Monitoring System for the Study of Autotrophic Biofilms in Bioremediation of Polyaromatic Compounds
Alarie, Jean P. (Oak Ridge National Lab., Oak Ridge, TN); A. Bruttig; G.H. Miller; W. Hill; T. Vo-Dinh.
Environmental Monitoring and Remediation Technologies.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 3534, p 670-676, 1999

A project is underway to identify naturally occurring algae and evaluate their ability to absorb polyaromatic compounds from ground-water sources (i.e., streams). These algae could serve as natural water filters for streams contaminated with polyaromatic hydrocarbons (PAHs). The researchers investigated anthracene and pyrene as PAH model systems. A portable fiberoptic instrument capable of real-time measurements has been developed for screening PAHs in surface water and natural algae systems. Preliminary studies investigated the detection limits of anthracene and pyrene and the adsorption properties of two algae using fluorescence monitoring. An exposure study of the algae to 5 ppb anthracene was performed to investigate the ability of the algae to adsorb PAHs.

Multi-Frequency Synthetic-Aperture Imaging with a Lightweight Ground Penetrating Radar System
Koppenjan S.K. (Special Technologies Lab., Bechtel Nevada, Santa Barbara, CA); Allen C.M.; Gardner D.; Wong H.R.; Lee H.; S.J. Lockwood.
Journal of Applied Geophysics, Vol 43 No 2-4, p 251-258, 2000

DOE's Special Technologies Laboratory (STL), operated by Bechtel Nevada, has developed several frequency-modulated, continuous-wave (FM-CW), ground-penetrating radar (GPR) units. To meet technical requirements for higher-resolution data, STL and the University of California, Santa Barbara, are investigating advanced GPR hardware, signal processing, and synthetic-aperture imaging with the development of an innovative system to design and fabricate a lightweight, battery-operated unit that does not require surface contact, can be operated by a novice user, and can achieve improved resolution. The latter is accomplished by using synthetic-aperture imaging, which forms the subsurface images by fully utilizing the data sequences collectively along a scan path. The backward propagation algorithm is presented as the basic structure of the multiple-frequency tomographic imaging technique, and the conventional fast Fourier transform (FFT) method, which can be described as a degenerated case of the model where the computation procedure, is approximated under the narrow-beam assumption.

Multi Sensor System for Fast Analysis in Environmental Monitoring with an Application in Waste Water Treatment
Hennig, K.; T. de Vries; R. Paetzold; K. Jantos; E. Voss; A. Anders, Univ. of Hanover, Inst. of Biophysics, Hanover, Germany.
The 4th EARSeL Workshop: Lidar Remote Sensing of Land and Sea, 16-17 June 2000, Dresden.

The mobile multisensor system for in situ investigations presented here consists of a LIF spectrometer, a reflection spectrometer, and sensors for temperature, pH value, redox potential, and conductivity. Additional sensors can be integrated easily. This system is suitable for a fast analysis of a great number of environmental monitoring samples. The very short measuring time and the low costs of measurements are the main advantages of the system in comparison with standard chemical analysis. An example is given of a wastewater analysis to illustrate the characteristics of the system, with a neural network used as a evaluation model. The margin of error varies between 5 and 25% depending on the application. The system can be adapted to a variety of tasks.
Available at http://las.physik.uni-oldenburg.de/projekte/earsel/4th_workshop.html

Multifunctional Industrial Combustion Process Monitoring with Tunable Diode Lasers
Von Drasek, William A. (American Air Liquide); O. Charon; K. Mulderink; D.M. Sonnenfroh (Physical Sciences, Inc.) ; M.G. Allen.
Optical Methods for Industrial Processes.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 4201, p 133-141, 2001

Air Liquide and PSI are collaborating on the development of an in situ multi-functional near-IR tunable diode laser system specifically targeted for application in harsh combustion environments with flue gas temperatures >1600°C and high particle densities. The multiplexing capability of the diode laser system allows near simultaneous detection of CO, O2, and H2O. The researchers tested the sensor on a 700 kW oxy-fuel pilot furnace to evaluate the performance under simulated industrial conditions. They present the pilot test results for dynamic stoichiometry changes, effect of particle entrainment, and air infiltration monitoring.

Multiple Filtering Strategy for the Automated Detection of Ethanol by Passive Fourier Transform Infrared Spectrometry
Idwasi, P.O.; G.W. Small; R.J. Combs; R.B. Knapp; R.T. Kroutil, Center for Intelligent Chemical Instrumentation, Dept. of Chemistry and Biochemistry, Ohio University, Athens.
Applied Spectroscopy, Vol 55 No 11, Nov 2001

The authors evaluated digital filtering methods for use in the automated detection of ethanol in the presence of an ammonia interference from passive Fourier transform infrared (FTIR) data collected during laboratory and open air remote sensing experiments. A two-filter detection strategy based on the use of separate ethanol and ammonia filters was compared to an approach based on a single ethanol filter. When the spectrometer scanned ethanol and ammonia plumes generated from a heated stack, the two-filter strategy outperformed the single-filter approach with both the laboratory and field data in situations in which the ammonia interference dominated the ethanol signature.

Multisensor Array for Visual Detection of Chemical Agents
Asher, Sanford A., Pittsburgh Univ., PA. Dept. of Chemistry.
DTIC Order No: ADA386943. 19 pp, Dec 2000

The primary objective of this project is to develop Intelligent Polymerized Crystalline Colloidal Array (IPCCA) chemical sensing materials to monitor chemical agents. The work will provide proof-of-concept for this technology for use as a sensing motif for numerous CWA-related chemical species. The researchers will examine the sensitivity and selectivity of these materials, optimize the detection limits for arsenic species and nerve toxins, and characterize potential interfering species.

The full text of this report is available in PDF through the DTIC search engine at http://stinet.dtic.mil/str/tr_fields.html

Natural Attenuation Test Kit
American Academy of Environmental Engineers, Annapolis, MD. Excellence in Environmental Engineering, 2001 Winning Projects. AAEE web site.

Among the American Academy of Environmental Engineers Excellence in Environmental Engineering awards presented in 2001, Camp Dresser & McKee, Inc. (CDM) of Belleview, WA, received the Grand Prize for Research for its natural attenuation test kit. Under funding from the U.S. Air Force, CDM developed and field-tested a natural attenuation test kit that includes two innovative analytical technologies: a self-contained, portable DH analyzer and a bioavailable Fe(III) assay. These technologies effectively and efficiently monitor these two key attenuation factors, and will generate valuable data further promoting natural attenuation as a viable treatment option. Research being conducted by the EPA, the U.S. Geological Survey, and other government and academic institutions currently uses the bubble-strip/ reduction gas analyzer for measuring DH. They also use weak acid extraction, or do nothing, to measure bioavailable Fe(III). CDM's novel analytical kit offers researchers additional tools to develop a better understanding of the environment and to develop new site cleanup technologies. The two test kits have applicability beyond natural attenuation; the test kit data can be used to optimize other remediation technologies, such as active attenuation and enhanced anaerobic bioremediation.
For more information, visit http://www.enviro-engrs.org/newlook/newtechnology.htm

Near Surface Soil Vapor Clusters for Monitoring Emissions of Volatile Organic Compounds from Soils
Ergas, Sarina J. (Univ. of Massachusetts, Amherst), Erich S. Hinlein, Paul O. Reyes, David W. Ostendorf; J. Pierre Tehrany (Phoenix-Pop Productions Inc., San Francisco, CA).
Journal of the Air & Waste Management Association, Vol 50 No 1, p 118-124, Jan 2000

This research described here is designed to provide an accurate, rugged, and easy-to-use method of monitoring air emissions of volatile organic compounds and other gases from soil surfaces. The results of field testing at a bioventing site are described. The method’s advantages include fast sampling time, low detection limits, and the ability to obtain real-time results without auxiliary equipment.

New 224 nm Hollow Cathode Laser—UV Raman Spectrometer
Sparrow, M.C.; J.F. Jackovitz; C.H. Munro; W.F. Hug; S.A. Asher, Dept. of Chemistry, Univ. of Pittsburgh, Pittsburgh, PA.
Applied Spectroscopy, Vol 55 No 1, Jan 2001

The researchers have developed an optimized high-throughput UV Raman spectrometer that utilizes a simple, inexpensive new 224.3 nm hollow cathode laser. The quasi-CW 224.3 nm laser can be used to detect sub-ppm concentrations of aromatic and polycyclic aromatic hydrocarbons in aqueous solutions.

New Analytical Applications with UV Fiber Bundles
Klein, Karl-Friedrich (Fachhochschule Giessen-Friedberg); B. Spangengerg (Fachhochschule Offenburg); H. Meyer (J&M GmbH); J. Mannhardt; J. Macomber (Polymicro Technologies, LLC).
Optical Fibers and Sensors for Medical Applications.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 4253, p 168-175, 2001

Due to UV fiber improvements within the last years, silica-based fibers with small core diameters are available for use in fiber bundles, extending the range of applications into the deep UV-region below 250 nm. A cross-section converter can be modified for use in a capillary holder for capillary electrophoresis. Y-assemblies for DUV- applications have been tested within the thin-layer chromatography, leading to an significant improvement of this 'old' technique. The short processing time, including the preparation and low cost, compare favorably to other separation techniques. Separation results of polyaromatic hydrocarbons with the proposed TLC method are used to illustrate the study.

New Approach of Spectral Characterization for Crude Oil Using Time-Resolved Fluorescence Spectra
Hegazi, E.; A. Hamdan; J. Mastromarino, Laser Research Section, Center for Applied Physical Sciences, Research Inst., King Fahd Univ. for Petroleum and Minerals, Dhahran, Saudi Arabia.
Applied Spectroscopy, Vol 55 No 2, Feb 2001

In a study of the spectral characterization of four crude oils by a time-resolved laser-induced fluorescence (TRF) technique, the TRF spectra were excited by a pulsed UV laser radiation at 250 nm, and measured at specific time windows of equal gate widths along the trailing edge of the pulsed laser. Contour diagrams of equal fluorescence intensities served as unique fingerprints for the crude oils. The method is particularly attractive for remote characterization of crude oil.

New Portable Device Senses Chemical Weapons
University of Delaware News Release, 5 Dec 2001

Researchers at the University of Delaware have developed a portable detection platform that could provide real-time recognition of chemical and biological weapons using infrared spectroscopy. A patent is pending on the Planar Array IR (PA-IR) spectrograph developed by John Rabolt, chairperson of the Department of Materials Science and Engineering, and Mei-Wei Tsao, research professor in that department. The device, which is now about the size of a large shoebox, can detect even small amounts of chemical weapons agents in solid, liquid, or vapor phases. It is also possible that the device can sense chemical agents at a distance, although further research on that is now being conducted. Although its ability to detect chemical and biological weapons is of great interest given the recent terrorist attacks, the device also has broad industrial applications. It can be used to make real-time measurements of the thickness and chemical composition of various films, coatings, and liquids.
The new UD system offers high sensitivity, fast data acquisition, and the absence of moving parts. The unit has been characterized as rugged, portable, and reliable.

New Sensor Upgrades Artificial Bomb Sniffers
American Chemical Society, 11 Nov 2001

Researchers led by David R. Walt of Tufts University in Medford, MA, have developed a disposable plastic sensor to enhance efficiency of the artificial nose, a high-tech sniffing device they hope will improve detection of bombs and landmines. Although a practical device may be at least five years away from actual use, the researchers say their new sensor will improve the sensitivity and reliability of current prototypes. Their findings are reported in the November 1, 2001, issue of Analytical Chemistry. The sensors must be made more user-friendly and able to recognize a wider array of odors. Most sensors tend to degrade over time, so they need to be resensitized frequently to recognize target odors in a process akin to replacing a dead battery with a fresh one. The new sensor is made with specially designed disposable fluorescent polymer beads. Because the beads are conditioned not to need odor-recognition training, degradation and retraining problems could be eliminated. Billions of the sensor beads can be made at once, as needed, providing a continuous replacement stock. To test their sensor, the researchers developed a stock of polymer beads that is sensitive to nitroaromatic compounds similar to those used in explosives. The sensor containing the initial bead-array detected the compounds with 98% accuracy. When beads from the same batch were installed in a different array and tested six months later, they detected the compounds with similar accuracy (94%), demonstrating successful odor memory transfer from one bead array to another. About the size of a desktop computer right now, today's prototypes could also be miniaturized to fit wands carried by soldiers or robots. Eventually, sensors also may be able to detect diabetes and cancer on the basis of breath odors, similar to breath-analyzer tests for alcohol. This research was funded by grants from the Air Force Office of Scientific Research / Defense Advanced Research Projects Agency, DOE, and the Office of Naval Research.

New View of Bacteria-Mineral Interface to Advance Bioremediation
Idaho National Engineering and Environmental Laboratory News Release, 11 Dec 2001

Researchers studying the feasibility of in situ bioremediation have a new tool for their analytical arsenal. DOE's Idaho National Engineering and Environmental Laboratory (INEEL) can now precisely map mineral crystals and bacterial growth on basalt using a customized laser imaging Fourier transform mass spectrometer. In the first reported application of imaging Fourier transform mass spectrometry (FTMS) to the field of biogeochemistry, INEEL researchers created high-resolution pseudo-images showing the arrangement of minerals within basalt, and bacterial growth on the rock surface. Researchers are working to better understand why some microbes are attracted to specific minerals so microbial populations can be harnessed for bioremediation. The FTMS technique creates highly reproducible two-dimensional maps of the bacterial-mineral interface, providing critical information about bacterial metabolism. Researchers can also create three-dimensional images (depth profiles) by stacking the maps.

The scanning technique works in the same way a person reads text. The laser starts at the top left of a sample, scans across various locations in a row, and then returns to the left to start again. The FTMS detects the spectrum of the minerals and bacteria present, and stores that data in memory along with spatial information about the locations of each sample spot. At the end of the scan, researchers can assemble the data into a kind of paragraph of information they can decipher. The ability to take multiple data points and retain the spatial context of the information is a major advance for geomicrobiology research.

In the future, the team plans to study how bacteria change the mineral surfaces over time. As the team grows increasingly sophisticated in understanding the capabilities of this new application of FTMS and interpreting the data they collect, they will progress to multiple strains of bacteria to fully mimic the real world environment under the INEEL site. Understanding what environments subsurface bacterial populations prefer is a defining piece of the puzzle for researchers developing environmental remediation techniques. INEEL's discretionary Laboratory Directed Research and Development Program funds instrument development and testing. The LDRD program provides seed money to develop instrument capabilities at INEEL to address experimental needs related to the subsurface research projects. INEEL's Environmental Systems Research and Analysis (ESRA) program funds the geoscience portion of this research. Contacts: Lead researcher Jill Scott, (208) 526-0429, scotjr@inel.gov; Mary Kauffman, (208) 526-2684, kaufme@inel.gov; Paul Tremblay, (208) 526-9664, plt@inel.gov. For more information, visit http://newsdesk.inel.gov/press_releases/2001/12-11mass_spectrometer_instrument.htm

A Newly Designed Compact Remote TDL Sensing System for Air Pollutants: Field Experiments and Comparison Measurements
Fischer, A. (Inst. fur Luft- und Kältetechnik Dresden, Dresden, Germany), R. Herzog, T. Lamp; A. Ropertz (Fachhochschule Düsseldorf, Düsseldorf, Germany), K. Weber.
The 92nd Annual Air & Waste Management Meeting & Exhibition, June 1999, St. Louis, MO, 13 p.

The remote sensing system for local or diffuse concentrations of gaseous air pollutants developed by the ILK Dresden is a compact and low mass apparatus based on tunable diode laser (TDL) techniques. The prototypes are characterized by compact design and stand-alone and mains-independent operation that allows fast, flexible, and mobile use. The first hardware version works as a one-laser monitor, while the advanced version provides for the simultaneous operation of two lasers; it can measure two gaseous pollutants at the same time. This paper presents results of field measurements of gaseous pollutants—automobile emissions and landfill gases—in the open atmosphere. TDL system and commercial remote sensing systems for air pollutant monitoring (FTIR and DOAS systems) were evaluated in different comparison measurements under real field conditions. The authors review the advantages of the ILK monitoring system and present the status of successful applications.

NIBA: A Non-Intrusive Bulk Analyzer for RCRA Metals
Womble, Phillip (Western Kentucky Univ.), George Vourvopoulos; Georgi Georgiev (Univ. of Florida).
Spectrum 2000: International Conference on Nuclear and Hazardous Waste Management, 24-28 September 2000, Chattanooga, Tennessee. CD-ROM

A prototype analyzer is being developed for the assay of metals whose emissions are regulated under RCRA. These metals—chromium, mercury, lead, and cadmium—pose particular problems for incinerator facilities where RCRA and the Clean Air Act limit the emissions of these metals.

A Non Destructive Method to Characterise Diesel Contaminated Soils
Kanaf, Djaouida; Nabil Amara, GeoEngineering Centre Queen's-RMC, Royal Military College of Canada, Kingston, Ontario.
Proceedings of the 2nd International Symposium and Workshop on Time Domain Reflectometry for Innovative Geotechnical Applications, 5-7 September 2001, Northwestern University, Evanston, IL. Infrastructure Technology Institute, Northwestern University, Evanston, IL. ISBN: 0-9712631-0-8.

Time Domain Reflectometry (TDR) is a geophysical method based on the exploitation of the dielectric properties of the soil. This technique is non-destructive, accurate, and simple to use method in measuring the water content of clean saturated and unsaturated soils and also has shown good efficiency in determining migration pathways of DNAPL and LNAPL contaminants. However, the application of this technique to hydrocarbon contaminated soils has been generally restricted to fluid saturated soils. The main objective of this study is to identify the effect of diesel presence and its concentration on the TDR signal reflected by an unsaturated diesel-contaminated soil. The study has been complicated by the inhomogeneous distribution of air in the soil samples and the closeness of the dielectric constants values of air, diesel, and soil, respectively about 1, 2.88, and 4. The experimental device is comprised of an excitation unit and an acquisition unit. The excitation unit is essentially constituted by a TDR signal generator that emits an electromagnetic step pulse through a two-rod TDR probe inserted in the soil sample. The reflected signals by the soil samples are collected by a PC, which constitutes the acquisition and processing unit. The PC also controls the excitation unit via a command interface. The device can be entirely automated to minimize human intervention.
http://www.iti.northwestern.edu/tdr/tdr2001/proceedings/tdr2001.zip [Note: This is a very large file!]

Non-Invasive Determination and Monitoring of Free-Phase Dense Nonaqueous Phase Liquids (DNAPLS) by Seismic Reflection Techniques
Waddell, M.G.; W.J. Domoracki; T.J. Temples, Earth Sciences and Resources Inst., Univ. of South Carolina Columbia, Columbia.
Industry Partnerships for Environmental Science and Technology Conference, 2000.
U.S. DOE, National Energy Technology Laboratory. 36 pp, 2000

Seismic reflection surveying and seismic reflect ion AVO analysis are noninvasive techniques that, under certain circumstances, provide a means of mapping subsurface lows where DNAPL might accumulate, and directly detect the presence of free-phase DNAPL in the subsurface. This approach can significantly reduces the cost of site characterization and prevents cross-contamination between aquifers by reducing the number of monitoring wells. The seismic reflection survey is a subsurface remote sensing method capable of providing dense spatial sampling of subsurface material properties at depths 30 feet and greater. The geophysical techniques proposed are well established in the petroleum industry, where they have been applied in an extensive range of geological settings. It remains to implement the technology in the hydrogeological and subsurface contamination remediation industries.
http://www.fetc.doe.gov/publications/proceedings/00/ind_part00/em4-1.pdf

Nonlinear Seismo-Acoustic Land Mine Detection
Donskoy, Dimitri M. (Stevens Inst. of Technology, Hoboken, NJ); Alexander E. Ekimov; Nikolay Sedunov; Michael Tsionskiy.
142nd ASA Meeting, December 2001, Fort Lauderdale, FL

In June 2001, the authors successfully conducted field test of the nonlinear seismo-acoustic detection technique at the U.S. Army testing ground. Plastic antitank mines (M19, VS1.6, VS2.2) were confidently detected at 5 in. depth in both gravel and dirt testing lanes. Plastic antipersonnel mines (M14, VS50, TS50) were also confidently detected up to 2 in. depth in both gravel and dirt lanes. Mine M14 is one of the smallest mines and very difficult to detect. The test proved that the nonlinear seismo-acoustic detection algorithm is very sensitive to AT and AP mines, while completely insensitive to false targets, such as rocks, chunks of metal, or wood, thus promising to deliver high

probability of detection with low false alarm rate. Available at
http://www.acoustics.org/press/142nd/donskoy2.html

A Novel Method for the Detection of MTBE: Ion Mobility Spectrometry Coupled to Multi Capillary Column
Xie, Z.; S. Sielemann; H. Schmidt; J.I. Baumbach, Inst. of Spectrochemistry and Applied Spectroscopy, Dortmund and Berlin, Germany.
International Journal for Ion Mobility Spectrometry, Vol 4 No 1, p 77-83, 2001

A combination of an ion mobility spectrometer with radioactive ionization source and equipped with a multi-capillary column was used as a new analytical method for the detection of MTBE, a gasoline additive that has become a potential water pollution problem. To extract MTBE from water, a membrane extraction unit was set up, which is simple, effective, and easy to automate with respect to further applications. For one extraction, the analyte was extracted directly out of the water with the membrane completely steeped in the water. For another extraction, the membrane was held in the gas phase over the surface of the water (head space). The minimum detectable limit for both methods was about 50 ppbvl of MTBE in water and the reproducibility with a rather high standard deviation of 8.9% (head space) and 11.5% (aqueous phase). The utility of the system for on-site and on-line measurements is briefly discussed.

On-Line Monitor Detects Metals in Steelmaking Fumes
Metalproducing, Vol 33, Sep 1999

To improve the efficiency of making steel, an X-ray fluorescence instrument has been developed for on-line analysis of metals in fumes arising from basic oxygen furnaces and electric arc furnaces (EAF). Developed by British Steel, the Waste Fume Analyzer, now offered by EDAX, Inc., has been used to measure iron losses in real time to develop process improvements that minimize these losses. Systems are operating at British Steel's Teesside and Llanwern plants and at the Hoogovens plant at IJmuiden, The Netherlands. The XRF can also be used to monitor atmospheric emissions from basic oxygen furnaces. Preliminary results exhibit a good correlation between emission levels measured at the cold end, i.e., on the stack after quenching, and waste-gas cleaning plant conditions. This result can aid in optimizing gas cleaning by adjusting the pollution control equipment parameters to the specific levels required for any particular blow. This in turn could lead directly to cost savings by reducing the energy consumed by the waste-gas cleaning plant.

Novel Route to Faster Fourier Transform Infrared Spectroscopic Imaging
Bhargava, R.; M.D. Schaeberle; D.C. Fernandez; I.W. Levin, Lab. of Chemical Physics, National Inst. of Health, Bethesda, MD.
Applied Spectroscopy, Vol 55 No 8, Aug 2001

The authors present a novel collection technique for step-scan, micro-imaging spectrometers that both allows large numbers of samples to be imaged rapidly and provides higher signal-to-noise ratios (SNRs) for given experimental time intervals. For example, data may be collected in as little as one minute, while SNRs greater than 800 are achieved for data acquired in less than 10 minutes. Imaging data acquired in the proposed approach show no loss in fidelity compared to data recorded by the conventional imaging techniques.

On-Line Screening of Water Quality by FLUO-IMAGER Monitor
Babichenko, S., and L. Poryvkina, (Inst. of Ecology/LDI, Tallinn, Estonia); F. de Vos (Skalar Analytical, The Netherlands).
The 4th EARSeL Workshop: Lidar Remote Sensing of Land and Sea, 16-17 June 2000, Dresden.

The FLUO-IMAGER monitor is intended for the analysis of organic compounds in natural, domestic, and technological waters in an on-line mode. The analytical concept uses the technique of spectral fluorescent signatures (SFS). The measurement technology serves for simultaneous detection, identification, and quantification of different types of crude oil and fuel oil, technical lubricants, polyaromatic hydrocarbons, phenols, and their derivatives in waters down to sub-ppm levels. Values for DOC, COD, turbidity, and suspended matter are also derived using absorption, scattering, and fluorescent data delivered by the hardware and the software of the instrument. Used in fast screening mode, the FLUO-IMAGER provides a powerful identification and quantification technique in the monitoring and control of water quality in a variety of application fields. On-line screening for organic pollutants in industrial waste water effluents, power plant cooling water, process waters, and natural water basins are examples of the versatility of the technique.

Optical Supramolecules for Chemical and Physical Sensing
Nocera, Daniel G., Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.
NTIS: ADA395213, 19 pp, Nov 2000

Proposal F49620-98-1-0203 addresses the diverse chemical and physical sensing needs of the United States Air Force. All the techniques developed in this program are based on monitoring a bright luminescence from a molecule or supramolecule reporter site. By controlling the rates for energy flow within the supra/molecular architecture, the intensity and lifetime of the luminescence may be adjusted to address chemosensing and physical sensing applications of interest to the Air Force. Sub-projects within F49620-98-1-0203 included the development of an optical chemosensor for the detection of polyaromatic signatures of JP4, and the development of new optical diagnostic techniques to measure vorticity and pressure over aerodynamic surfaces.

Optical Properties of Gaseous 2,4,6-Trinitrotoluene in the Ultraviolet Region
Usachev, A.D.; T.S. Miller; J.P. Singh; F.-Y. Yueh; P.-R. Jang; D.L. Monts, Diagnostic Instrumentation and Analysis Lab., Mississippi State Univ., Starkville.
Applied Spectroscopy, Vol 55 No 2, Feb 2001

Absorption spectrum of gaseous 2,4,6-trinitrotoluene (TNT) was recorded by conventional absorption spectroscopy (AS) in the spectral regions 195-300 nm, as well as by cavity ringdown spectroscopy (CRDS) methods in the spectral regions 225-235 nm. The limit of detection of TNT vapor by CRDS was less than 1 ppb. TNT evaporation rates were found to be 7x108 and 4x1010 molecules/cm^2 x sec at 21 and 37°C, respectively.

Optical Sensing Device Containing Fiber Bragg Gratings [Patent application, filed 1 Aug 2000]
Todd, Michael D., Dept. of the Navy, Washington, DC.
Report No: PAT-APPL-09 917 643, DTIC Order No: ADD019963. 33 pp, Aug 2000

This patent application details a new optical sensing device containing fiber Bragg gratings: a scanning bandpass filter, an interferometer, and multiple photodetectors. The invention also involves a new

system and method for fibre Bragg grating (FBG) sensor interrogation and multiplexing. The system combines a scanning Fabry-Perot (SEP) bandpass filter used to wavelength-multiplex multiple gratings in a single fiber, and an unbalanced Mach-Zehnder fibre interferometer made with a 3 x 3 coupler to detect strain-induced wavelength shifts. The system includes a passive technique for interferometer drift compensation using non-sensing FBGs. A complete prototype system interrogates four gratings in a single fiber at a Nyquist sampling rate up to 10 kHz, with a noise floor measured near 4 nEpsilon Hz-"2 above 0.1 Hz. The inclusion of the interferometer drift compensation technique is shown to make quasi-static measurements feasible.
The full text of this report is available in PDF through the DTIC search engine at http://stinet.dtic.mil/str/tr_fields.html

Optimization of Raman Spectroscopy for Speciation of Organics in Water
Collette, T.W.; T.L. Williams; J.C. D'Angelo, NERL, U.S. EPA, Athens, GA.
Applied Spectroscopy, Vol 55 No 6, Jun 2001

A method for determining constants for simultaneously occurring, site-specific "microequilibria" for organics in water is based in part on modeling temperature-variant Raman spectra according to the van't Hoff equation. Spectra are measured with a CCD-based, dispersive Raman spectrometer. Success of the method depends on accurate quantification of small spectral changes that are monotonic with temperature due to changes in relative concentration of equilibrium components. The researchers found they could typically reduce frequency and intensity fluctuations to tolerable levels by normalizing all spectra based on the atmospheric N2 stretching band at 2331 cm-1, which is observed in all of the spectra. If areas of depolarized bands were used in the modeling, they also could typically neglect the temperature dependence of Raman spectra.

OTDR Distributed Sensing of Liquid Hydrocarbons Using Polymer-Clad Optical Fibers
Bürck, J.; S. Roth; K. Krämer; H. Mathieu.
Proceedings of the 2nd International Symposium and Workshop on Time Domain Reflectometry for Innovative Geotechnical Applications, 5-7 September 2001, Northwestern University, Evanston, IL. Infrastructure Technology Institute, Northwestern University, Evanston, IL. ISBN: 0-9712631-0-8.

This paper presents different approaches for distributed measurement of hydrocarbons using optical fibers, all based on a polymer-clad silica optical fiber connected to an optical time-domain reflectometry (OTDR) instrumental set-up. Hydrocarbons (HCs) are detected by discrete changes in the backscatter waveform caused by penetration of HCs into the fiber cladding. HC penetration can affect the light guiding properties of the fiber and thus the backscatter signal through different analyte / evanescent wave interactions (local refractive index (RI) change, light absorption or fluorescence emission). HC location is possible along fibers with lengths of up to 1.5 kilometers and the analyte signals contain information about the length of the fiber section that contacts the chemical and the HC concentration. The sensing fiber has been adapted to a mobile mini-OTDR instrument and HC location based on RI changes in the cladding, yielding a minimum spatial resolution of 1 m.
http://www.iti.northwestern.edu/tdr/tdr2001/proceedings/tdr2001.zip [Note: This is a very large file!]

Outer Membrane Proteins of *Pseudomonas* As Immunochemical Markers
Nybroe, Ole; Lene Kragelund; Kristine Leopold, Dept. of Ecology and Molecular Biology, Royal Veterinary and Agricultural Univ., Frederiksberg C, Denmark.
MAREP International Conference on Marker/Reporter Genes in Microbial Ecology, 14-17 June 1997, Stockholm, Sweden. Extended Abstracts.

The fluorescent pseudomonads constitute a group of ubiquitous bacteria and include several pathogenic species, as well as species that can degrade polluting compounds or prevent plant diseases caused by pathogenic fungi. Consequently, this bacterial group has a potential application in environmental biotechnology. Monitoring systems are needed to address their colonization of natural habitats and their interactions with biotic and abiotic factors in the environment. Immunological markers provide detection of single cells by immunofluorescence microscopy if the selected marker is abundant. The marker systems can be designed to have narrow as well as broad specificity, and hence can target indigenous bacteria that have not been genetically modified by insertion of a reporter gene. The optimal assay should provide nondisruptive detection of individual cells, which calls for surface-exposed immunological markers. At the surface of Gram-negative bacteria, including pseudomonads, the outer membrane serves as a structural cell compartment, and interactions between the cells and their environment takes place through outer membrane structures. The outer membrane contains two classes of molecules that are relevant as targets for antibodies: lipopolysaccharides (LPS) and proteins. In *Pseudomonas*, LPS-targeted antibodies provide serogroup-specific detection of intact cells and LPS seem to be a stable marker expressed under all tested growth and starvation conditions. Outer membrane proteins can be constitutively expressed structural components, or they can be dynamically regulated in response to environmental stimuli. The authors summarize the properties of two major *Pseudomonas* outer membrane proteins belonging to each of these functional classes and their utility as immunological markers.
Extended abstracts available at http://www.sh.se/marep/program.html

Part I. Development of Low Power, Reduced Pressure Plasma Ionization Sources for Mass Spectrometry: The Potential for Enhanced Speciation Studies. Part II. Application of Inductively Coupled Plasma Mass Spectrometry with High Performance Liquid Chromatography for Chromium Speciation of Chromium Complexed Azo Dyes
Waggoner, Joseph Wilbert, Ph.D. dissertation, Univ. Of Cincinnati.
University Microfilm, UMI Pub No AAT 9991846. ISBN: 0-493-00533-1. 115 pp, 2000

Low power, reduced pressure (LP/RP) plasmas are under investigation as ionization sources for mass spectrometry due to the potential for providing qualitative information not obtainable with conventional inductively coupled plasma mass spectrometry (ICP-MS). The addition of molecular mass spectra capabilities to trace elemental detection would be a significant advance in the field of elemental speciation. A novel, lab manufactured LP/RP-He-ICP was interfaced with quadrupole mass spectrometry and gas chromatography for detection of four organotin species-tetramethyltin (TMT), tetraethyltin (TET), trimethylphenyltin (TMPT), tetrabutyltin (TBT), and three volatile organobromine species: bromobenzene, 1-bromoheptane, and benzyl-bromide. Sub-picogram and low picogram elemental limits of detection were achieved for the organotin and organobromine species, respectively. Molecular mass spectra exhibiting characteristic fragmentation patterns resembling spectra from electron impact mass spectrometry (EI-MS) were extracted from the total ion chromatograms. Molecular ions for all three organobromine compounds were observed. A mixed gas He/Ar radio frequency glow discharge (RF-GD) source was evaluated for tunable fragmentation capabilities. For tetramethyltin (TMT), the ratio of the elemental tin fragment intensity to the molecular fragment intensity was plotted versus the He/Ar plasma gas composition. Tunability towards more elemental fragmentation was observed with the addition of argon. Overall sensitivity for elemental tin decreased with the addition of argon to the plasma gas.

Pattern Recognition Analysis of Optical Sensor Array Data to Detect Nitroaromatic Compound Vapors
Bakken, G.A. (Dept. of Chemistry, Pennsylvania State Univ., University Park), G.W. Kauffman, P.C. Jurs; K.J. Albert (Max Tishler Lab. for Organic Chemistry, Tufts Univ., Medford, MA), S.S. Stitzel.
Sensors and Actuators B, Vol 79, p 1-10, 2001

The researchers employed a fiber optic-based sensor array to determine the presence or absence of nitroaromatic compound vapors in variable backgrounds of VOC vapors. A previously developed cross-reactive array technology forms the base of the system, which relies on a sensor array attached to the distal tips of an optical fiber bundle. The system was trained to recognize the presence of explosives-like nitroaromatic vapors. Based on fluorescent responses, samples in a prediction set were classified with 100% accuracy using models trained to determine if nitroaromatic vapors were present. Two of the vapors used in development and testing were chosen because they are commonly detected on the soil surface above buried plastic land mines containing TNT.

Pattern Recognition and Image Processing for Environmental Monitoring
Siddiqui, Khalid J. (SUNY/Fredonia); DeLyle Eastwood (Air Force Institute of Technology).
Environmental Monitoring and Remediation Technologies II.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 3853, p 60-71, 1999

The authors review the state of the spectral techniques as applied to environmental monitoring and describe a spectral pattern classification system with automatic decision-theoretic approaches for classification. The system can be used for analysis of large data sets, warehousing, and interpretation. In a preliminary test, the system was used to classify synchronous UV-vis fluorescence spectra of relatively similar petroleum oils with reasonable success.

Performance Comparisons of Conventional and Line-Focused Surface Raman Spectrometers
Ramsey, J.; S. Ranganathan; R.L. McCreery; J. Zhao, Ohio State Univ., Columbus.
Applied Spectroscopy, Vol 55 No 6, Jun 2001

The authors present a new spectrometer design employing line focusing and collection, with f/2 optics and a 6 mm slit image at the CCD. A proprietary aberration correction prevents slit image curvature common to most spectrographs with low f/#, and permits full height binning of the CCD. The line focused spectrometer yielded a signal to noise ratio (SNR) and F_{SNR} comparable to a point focus using the same collection optics and slightly lower than the most efficient spectrograph examined. The line focus permitted much lower power densities to be employed, or yielded much larger signal for the same power density as a point focus. The new line-focused design yielded an SNR 67 times that of the best point-focused system for the same sample, measurement time, and laser power density.

Performance Evaluation of Laser-Induced Breakdown Spectrometry as a Multimetal Continuous Emission Monitor
Zhang, Hansheng; Fang-Yu Yueh; Jagdish P. Singh, Diagnostic Instrumentation and Analysis Lab., Mississippi State Univ., Starkville.
Journal of the Air & Waste Management Association, Vol 51 No 5, May 2001

Laser-induced breakdown spectroscopy (LIBS) has been evaluated as a multi-metal continuous emissions monitor (CEM) at the U.S. EPA rotary kiln incinerator simulator facility in Raleigh, NC. The LIBS system successfully measured Cd, Be, Cr, and Pb at the regulated level and demonstrated its capability as the process monitor. However, the current LIBS system is not yet sensitive enough for Hg, Sb, and As at the EPA-regulated level.

Performance Testing of a Multimetals Continuous Emissions Monitor
Selltzer, Michael D., Naval Air Warfare Center Weapons Division, China Lake, CA.
Journal of the Air & Waste Management Association, Vol 50 No 7, p 1010-1016, Jul 2000

A prototype instrument designed for continuous monitoring of hazardous air pollutant metal emissions in the stack gases of waste incinerators and industrial furnaces has undergone a performance evaluation (including a relative accuracy test audit) that confirmed the instrument's ability to accurately measure stack gas metal concentrations. This paper discusses the design and operation of the multimetals continuous emissions monitor (MMCEM), its shrouded nozzle sampling system, and the results of the performance testing.

Performance Testing of Landfill Geoprotectors: Background, Critique, Development and Current UK Practice
Gallagher, E.M.; W. Darbyshire; R.G. Warwick.
Geosynthetics International, Vol 6 No 4, p 283-301, 1999

Geomembrane basal landfill liners are typically overlain by a stone drainage layer with a geoprotector layer placed between the drainage layer and the geomembrane to protect the geomembrane from environmental stress cracking caused by pressures transmitted through the stone drainage layer. This paper reviews the background information for a landfill liner cylinder test using site-specific materials, with commentary on the new test method from the perspectives of regulator, designer, manufacturer, and test institution. The test standardizes the apparatus, testing procedure, method of measuring deformations, and calculation of local strains.

Picosecond Time-Resolved Fluorescence Instrumentation for Chemical and Physical Sensing
Nocera, Daniel G., Massachusetts Inst. of Technology, Cambridge. Dept. of Chemistry.
Report No: 6813700 FINAL, NTIS: ADA383200. 15 pp, Sep 2000

A laser system, optical train and detection electronics were constructed for the measurement of picosecond luminescence dynamics. The instrumentation provided new experimental capabilities for AFOSR program F49620-98-1-0203 (Optical Supramolecules for Chemical and Physical Sensing, PI - Daniel G. Nocera), which addresses diverse chemical and physical sensing needs of the U.S. Air Force. The new sensing techniques developed in the program all are based on monitoring a bright luminescence from large molecules or supramolecules. The instrumentation provided information on the most fundamental parameter for defining the crucial photophysical property governing

luminescence, the excited state lifetime from which the essential nonradiative and radiative rate constants could be derived. By using the instrumentation to follow the excitation energy in real time about the supramolecules, pathways that lead to non-constructive luminescence were designed out of the molecule, thus allowing the program to create optimized supramolecules to meet Air Force sensing needs.
The full text of this report is available in PDF through the DTIC search engine at
http://stinet.dtic.mil/str/tr_fields.html

Polarized Light Scattering as a Rapid and Sensitive Assay for Metal Toxicity to Bacteria
Li, Z.Z.; J. Czege; B.V. Bronk, Uniformed Services Univ. of the Health Sciences, Bethesda, MD.
NTIS: ADA396158, 12 pp, Jul 2001

This paper describes a new method that utilizes the scattering of polarized light from a suspension of bacteria to assay the effect of toxins. The method compares the time dependence of changes in an angular scattering pattern obtained from a suspension of *Escherichia coli* bacteria with no toxin exposure to the corresponding, but reduced, changes that occur when there is exposure to a small concentration of certain toxicants. The changes are due to growth of a specially prepared population of these bacteria. The changes in the pattern normally reflect a change in average bacterial size due to growth, whereas the reduction of the change in pattern occurs when there is rapid cessation of bacterial growth. The method was tested with varying concentration of the ions of five different heavy metals. The results using this method during the first few minutes after exposure to the toxicant were compared to the relative survival of colony-forming units of the bacteria. The graphs for the two methods were found to be approximately parallel for each of the five metals examined. This result indicates that the toxic effect of these metals takes place relatively quickly for these bacteria. These results were compared with results available from the literature for the same metals but using other methods for measuring the toxicity to bacteria.

Pollutant Emission Monitoring Using QC Laser-Based Mid-IR Sensors
Allen, M.G. (Physical Sciences Inc.), D.M. Sonnenfroh, W.T. Rawlins; C.G. Gmachl (Lucent Technologies/Bell Labs.), F. Capasso, A.L. Hutchinson, D.L. Sivco, J.N. Baillargeon, A.Y. Cho.
Water, Ground, and Air Pollution Monitoring and Remediation, 6-7 November 2000.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 4199, p 86-97, 2001

This paper reports recent progress toward the development of room-temperature laser-based sensors for combustion-generated pollutants such as NOx and SOx. Laboratory measurements of SO_2 at 8.6 micrometers were obtained with detection limits on the order of 1 ppm. The authors present extensions of these approaches for higher sensitivity measurements in exhaust gas conditions.

Polymer-Based Optical Single-Arm Waveguide Interferometer as a Chemical Sensor
Diggs, Darnell E. (Alabama A&M Univ.); Sergey S. Sarkisov; Michael J. Curley; Grigory Adamovsky (NASA Glenn Research Ctr.).
Linear, Nonlinear, and Power-Limiting Organics.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 4106, p 31-42, 2000

The authors report on a single-arm double-mode waveguide interferometer used as a chemical sensor for detecting ammonia and other pollutants in ambient air. The sensor is based on thin films of polymers such as poly(methyl methacrylate) and polymide doped with indicator dyes, such as bromocresol purple. The dye-doped polymer materials significantly increase their optical absorbance in the presence of the pollutants. Single-arm configuration makes it rigid, but sensitive enough to detect concentrations of ammonia of the order of 10 ppm and less. The device also exhibits high sensitivity to ambient temperature change. Design and fabrication issues are discussed, including problems such as coupling the sensor to the optical fiber transmission line, reduction of losses, and sensitivity improvement.

Polynuclear Aromatic Hydrocarbon Analysis Using the Synchronous Scanning Luminoscope
Hyfantis, George J. (Environmental Systems Corp.); Matthew S. Teglas; Robert G. Wilbourn.
Water, Ground, and Air Pollution Monitoring and Remediation.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 4199, p 115-123, 2001

The Synchronous Scanning Luminoscope (SSL) is a field-portable, synchronous luminescence spectrofluorometer capable of quantitative analysis of total polynuclear aromatic hydrocarbons (PAHs) to the parts per billion range using phosphorescence and fluorescence techniques with a high correlation to laboratory data, as illustrated by the study presented here. This paper describes standard field methods for using the SSL and describes the results from laboratory testing of PAHs and from trials conducted at two different hazardous waste sites.

A Portable Fiber-Optic Chemical Device for the Quantitative Determination of Carbon Monoxide from Automobile Exhaust Emissions
Matias, F.A.A.; M. Tubino, Univ. Estadual de Campinas, Campinas-SP, Brazil.
Journal of the Air & Waste Management Association, Vol 51 No 7, Jul 2001

This paper describes a colorimetric method for the quantitative analysis of carbon monoxide (CO) in automobile emissions via an instrument using diffuse reflectance that allows rapid CO determination in exhaust gases directly from the tailpipe.

Preparation, Characterization, and Application of Organic Light Emitting Diodes
Friedl, Jon Hiram, Jr., Master's thesis, Iowa State Univ., Ames. 46 pp, 1999

This thesis describes the experimental procedure used for the thin film evaporation system, including vacuum chamber characteristics, film thickness monitoring equipment, and improvements to the system. A mathematical model for the deposition mechanism is presented, highlighting the effect of geometry using the distributions for two types of ideal source emitters--point and small plane sources--to develop relative thickness distributions for two types of ideal source emitters at two source distances and nominal film thicknesses. These results are followed by a description of other types of emitters and approximating them using the two ideal emitters already modeled. Finally, device fabrication is discussed, specifically the substrate cleaning process, an optional aquaregia treatment of the ITO/glass substrate used to improve the performance of the devices, the typical film thicknesses of organic LEDs presented in this thesis, and two types of masks used for the final thick aluminum contact layer. Next is outlined the procedures and equipment used to fabricate and test DPVBi organic LEDs. Chapter Four is the primary supporting document for a Record of Invention submitted to the Iowa State University Research Foundation (ISURF) jointly by Iowa State University and the University of Michigan. It is entitled ‘Novel Integrated Organic LED/Optical Sensor Devices’ and describes a novel all-organic miniature solid-state oxygen sensor. On one side of a transparent substrate is a blue emitting organic LED; on the other side is a porous sol-gel matrix that contains a dye whose photoluminescence

intensity and lifetime are quenched when exposed to molecular oxygen. The sensor's response to gaseous oxygen is described, and its potential applications and technological impact are discussed.
http://www.public.iastate.edu/~cmpexp/groups/shinar/MS_Thesis-Friedl.doc

Product Guide: Water and Air Instrumentation
Pollution Engineering, p 42-47, Nov 1999

This article includes an extensive list of air and water analyzer suppliers by pollutants measured and by measuring technique.
http://www.pollutionengineering.com/archives/1999/pol1101.99/1199toc.htm

Prototype Design and Laboratory Performance Evaluation of a Novel Near-Real-Time Portable Analyzer for Indoor VOCs and SVOCs
Lu, C.; E. Zellers, Univ. of Michigan, Ann Arbor, MI.
American Industrial Hygiene Conference & Exposition, 2-7 June 2001, New Orleans, Louisiana

This presentation concerns the development a novel analyzer that employs multi-stage preconcentration, tunable GC separation, and detection with an array of microfabricated chemical sensors for IAQ assessments of common indoor VOCs and SVOCs. A four-stage mini-preconcentrator containing Carbotrap Y, Carbopack B, Carbopack X, and Carboxen 1000 (14 mg total) has been developed for this application. Tests have demonstrated the capability for trapping 44 vapors, each at 100 ppb, and thermally desorbing them directly into the chromatographic separation stage. The sensor array response patterns coupled with the retention time allows recognition and quantification of 44 analytes.

Prototype of On-Chip Signal Processing for Handheld Chemical Agent Sensors
Ih, Charles S.; Baohua Zhuang, Delaware Univ., Newark.
DTIC Order No: ADA386715. 10 pp, Dec 2000

Two systems of the on-chip signal processing for hand-held chemical agent sensors have been investigated. The principle of one on-chip signal processing is dependent on the resistance changes of the chemical sensor or chemical materials. The other principle is dependent on the impedance test. One prototype was built and delivered. The other three prototypes can be demonstrated. Two detection/ amplification concepts were explored. The resolution of the relative resistance measurement is better than 10 to the minus 6th power. Suggestions for the future development are proposed.

The full text of this report is available in PDF through the DTIC search engine at
http://stinet.dtic.mil/str/tr_fields.html

Pyrolysis-GC/FID Test for Biogenic Interference in Contaminated Soil
Garland, D.S. (Water and Environmental Res. Center, Univ. of Alaska, Fairbanks); D.M. White; C.R. Woolard.
Journal of Cold Regions Engineering, Vol 14 No 1, p 1-12, 2000

'Biogenic interference' is that portion of natural organic matter in soil that cannot be distinguished from petroleum in a standard test for contamination. Biogenic interference is normally a small fraction of total natural organic matter, but in organic soils biogenic interference alone can exceed 'petroleum' limits set by regulatory agencies. A test using a pyrolysis-gas chromatograph/flame ionization detector (GC/FID) was developed to quantify biogenic interference in soil samples from northern Alaska. The samples had no known history of contamination, so all measured 'petroleum' was derived from biogenic interference. The pyrolysis test was found to predict biogenic interference in soil samples more accurately than any combination of standard soil tests, including C:N ratio, pH, percent organic carbon, extractable carbon, humic acids, fulvic acids, low molecular weight acids, hydrophobic neutrals, and hydrophilic neutrals. Analysis of samples contaminated in the laboratory confirmed that the pyrolysis test could quantify biogenic interference in soils recently contaminated by petroleum.

Qualitative Determination of Organic Pollutants in an Aquatic Environment by Laser-Induced Fluorescence Combined with Optical Fibers
Roubani-Kalantzopoulou, F. (National Technical Univ. of Athens); M. Kompitsas (National Hellenic Research Foundation); A. Mavropoulos; I. Bassiotis (National Technical Univ. of Athens).
Second GR-I International Conference on New Laser Technologies and Applications.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 3423, p 266-270, 1998

The need to qualitatively and quantitatively determine pollutants in the marine environment has led to the development of a new method based on the technique of laser-induced fluorescence combined with the use of optical fibers. The method depends on the appropriate selection of the wavelength excitation to permit the qualitative determination of contaminants such as gasoline and jet oil in water. The time-resolved spectroscopy method also has been applied successfully to identifying anthracene and pyrene in a mixture of both aromatic compounds, despite their spectral overlap and the weak fluorescence of pyrene.

Raman Spectroscopic Analysis of Fertilizers and Plant Tissue for Perchlorate
Williams, Ted L.; Robert B. Martin; Timothy W. Collette, U.S. EPA, Athens, GA.
Applied Spectroscopy, Vol 55 No 8, Aug 2001

This paper discusses the use of Raman spectroscopy for qualitative and quantitative analysis of 59 samples of fertilizers for perchlorate. The researchers also applied Raman spectroscopy to the qualitative identification of perchlorate in extracts of lettuce grown in a greenhouse using irrigation water spiked at 10 ppm with perchlorate, and the results were compared to results obtained via ion chromatography, which is the currently recommended method for perchlorate analysis.

Real Abilities and Problems of Laser Monitoring (In Situ) of Oil Pollution in Coastal Marine Waters
Boychuk, I.V., T.A. Dolenko, and V.V. Fadeev (Moscow State Univ.); M. Kompitsas (Theoretical and Physical Chemistry Inst., Athens, Greece); R. Reuter and Carl von Ossietzky (Univ. Oldenburg, Germany).
The 4th EARSeL Workshop: Lidar Remote Sensing of Land and Sea, 16-17 June 2000, Dresden.

This paper summarizes the results of laboratory and field experiments and computer modeling obtained by the authors in 1998-2000 within a joint INTAS project and the Russian federal program, Integratsiya. At oil pollution (OP) concentrations in water at concentrations of tens of micrograms per liter, the intensity of the fluorescence band is significantly lower than that of aquatic humic substances (AHS) typical of coastal waters. Generally, the OP and AHS fluorescence bands overlap (to a greater

or lesser degree at different excitation wavelengths), so it is necessary to solve the problem of extracting small contributions of OP fluorescence. The task is complicated by the effects of a possible interaction between components and changing OP fluorescence band parameters during its presence in the water (the 'aging' effect). The researchers investigated a possible solution to the problem by analyzing the seawater fluorescence band directly with sensitive instruments, and by fluorimetry with variable gating (a variant of the kinetic fluorimetry). Both methods are used in combination with the application of artificial neural networks (ANN). Spectra obtained for different OP in pure water and in water containing AHS at different concentrations were used as initial data for ANN training. The results of such a treatment of fluorescence spectra of real seawater samples from coastal water areas of the Black Sea, of model samples, and computer simulations, have demonstrated the real possibility of estimating OP concentrations in coastal water down to micrograms per liter. The application of the ANN technique to the analysis of fluorescence kinetic allows the determination of lifetimes of the excited states of fluorophores and their partial contributions, when information about their fluorescence band shape (with satisfactory accuracy) is not available.
Available at http://las.physik.uni-oldenburg.de/projekte/earsel/4th_workshop.html

Real Time Monitoring of Airborne Metals
Fraser, M.E. (Physical Sciences, Inc., Andover, MA); A.J.R. Hunter; S.J. Davis.
Environmental Monitoring and Remediation Technologies.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 3534, p 262-70, 1999

Physical Sciences Inc. (PSI) has developed a real-time monitor for lead and chromium based on spark-induced breakdown spectroscopy (SIBS). The basis of SIBS is a high energy breakdown creating atomic emission which is sensitively viewed with a radiometer. The technology was successfully demonstrated to detect low ppbw (µg/m3) concentrations of lead and chromium in incinerator stack gases at a joint DOE/EPA test 1997, airborne lead at a local firing range in the airspace of the shooters and in the ventilation system, and chromium at a hard chromium electroplating facility. The authors review their progress toward developing a commercially viable prototype.

Real-Time, Ultrasensitive Monitoring of Air Toxics by Laser Photoionization Time-of-Flight Mass Spectrometry
Castaldi, Marco J.; Selim M. Senkan, Univ. of California, Los Angeles.
Journal of the Air & Waste Management Association, Vol 48 No 1, p 77-81, Jan 1998

At present, no technology exists for the real-time detection of PAHs. When PAH emissions data are needed, they are acquired by using a variety of tedious techniques based on gas chromatography/ mass spectrometry or liquid chromatography/ fluorescence. These approaches are time consuming, expensive, and not suitable for continuous monitoring. The authors report on the development and use of a laser photo-ionization (LP), time-of-flight (TOF) mass spectrometer (MS) system for the ultrasensitive and real-time detection of PAHs in hot combustion products. The instrument has demonstrated a naphthalene detection sensitivity of 4 parts per billion.

The Relationship between SW-846, Performance Based Measurement Systems (PBMS), and Innovative Analytical Technologies
Report No: EPA 542-R-01-015, 8 pp, Oct 2001

This summary explains EPA's position regarding testing methods used within waste programs, documentation of EPA's position, the reasoning behind EPA's position, and the relationship between analytical method regulatory flexibility and the use of on-site measurements (also termed 'field analytical methods') to improve the cost-effectiveness of contaminated site cleanups. Although the flow of site cleanup work can be accelerated and site cleanup can be more economical when on-site analytical methods are used, the adoption of field methods has been hindered by misunderstandings about regulatory requirements for data quality and a traditional reliance on fixed laboratory methods to provide nearly all of the data upon which site decisions are based. Contrary to widespread opinion, EPA policy does NOT 'approve' (in a restrictive sense) which specific analytical methods may be used to generate most of the analytical chemistry data used within waste programs such as RCRA, Superfund, or other contaminated site cleanup programs. However, to support the analytical needs of the RCRA program (and by extension, other waste/contaminated site management programs), EPA has created and maintains a methods compendium entitled *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (also known as SW-846).
http://www.clu-in.org/download/techdrct/tdsw-846.pdf

Remote Mine Detection Technologies for Land and Water Environments
Hoover, Eddie R.
Remote Sensing Technologies for Minefield Detection and Monitoring, 17-20 May 1999, Easton, MD.
Report No: SAND99-1203C, 15 pp, 1999

This paper presents an overview of some of the technologies currently being investigated by Sandia National Laboratories for the detection and monitoring of minefields in land and water environments. The three technical areas described in this paper are: 1) the development of new mathematical techniques for combining or fusing the data from multiple sources for enhanced decision making; 2) an environmental fate and transport (EF&T) analysis approach that is central to improving trace chemical sensing technique; and 3) the investigation of an underwater range imaging device to aid in locating and characterizing mines and other obstacles in coastal waters.
http://www.osti.gov/bridge/product.biblio.jsp?osti_id=7250

Reporter Genes for Monitoring Microbial Cell Activity and/or the Environment: An Opinion
Bailey, Mark (Inst. of Virology and Environmental Microbiology, Oxford, UK); Philippe Corbisier (Vito, Mol, Belgium); Anne Glover (Univ. of Aberdeen, Aberdeen, Scotland); et al.
European Commission Biotechnology Programme, DGXII. 18 pp, Sep 1998

Eighteen experts have participated in the writing of this report (an opinion) at a workshop of the MAREP (Marker/Reporter Genes in Microbial Ecology), a concerted action sponsored by the European Commission Biotechnology Programme, DGXII. The report contains definitions of terms, selection of an appropriate reporter gene, practical aspects, applications of target genes and promoters, general approaches to use of reporters, future improvements for reporter genes, and two case studies, one of which assesses the use of a bacterial biosensor to monitor TNT degradation in soils contaminated with TNT and heavy metals. In contrast to chemical measurements, biosensors can provide information on pollutant bioavailability, as well as pollutant heterogeneity; offer the possibility of real-time monitoring of pollutants, and therefore are a cost effective management tool for waste management; allow effective assessment of bioremediation potential, and the constraints to bioremediation, through integration of physical and chemical factors present at a particular site; and potentially allow determination of pollutant levels in soil without damaging the spatial arrangement of soil, which is important for determining the potential for successful bioremediation.

For more information, visit http://www.sh.se/marep/doc/rep2.pdf

A Review of Chemical Sensor Technologies for Detection of Organic Compounds
Shyamprasad, Sangameswaran; Rominder P.S. Suri (rominder.suri@villanova.edu)
Civil and Environmental Engineering Dept., Villanova Univ. [file in Microsoft Word], 30 pp, 2001

The field of chemical sensors is one of the fastest growing areas in both research and commercial fields. The commercial field is growing at a rate of 10% per annum, and it has a market of ~$3 billion. Most of the research work in this field aims toward reducing the size of sensors and identifying and quantifying multiple species. Also, quick response, minimum hardware requirement, good reversibility, sensitivity, and selectivity are qualities expected of an excellent sensor, and these areas need further research. Chemical sensors have wide application in quality and process control, biomedical analysis, medical diagnostics, environmental pollution control, continuous and long-term monitoring of pollutants, forensics, fragrance analysis, and onelogy. The need to identify multiple analytes simultaneously has led to the development of array-based sensors. The design of cross-reactive array generates a pattern upon exposure to an analyte mixture. This pattern can be unique for a chemical and can be used to identify the chemical using a software. The human olfactory system is an example of a natural sensor. Extensive work has been done to mimic the function of this natural sensor to create an artificial nose that can detect very low concentrations of diverse chemicals and mixtures. Available under Current Research: Sensor Development at http://www93.homepage.villanova.edu/rominder.suri/

ScanSpec: an Imaging FTIR Spectrometer
Nelsson, Claes (Defence Research Establishment); Frans Lundberg (Linkoping Univ.); Paer Nilsson (Defence Research Establishment); Mattias Berglund (Swedish Armed Forces/Norrland Signals).
Targets and Backgrounds VI: Characterization, Visualization, and the Detection Process.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 4029, p 324-336, 2000

This paper describes how a hyperspectral IR imager was developed based on an FTIR spectrometer at the Defence Research Establishment (FOA) in Linkoping, Sweden. The ScanSpec system consists of a fast FTIR spectrometer from Bomem (MR254), an image-scanning mirror device with controlling electronics, and software for data collection and image forming. Some examples of hyperspectral results from maritime background and remote gas detection field trials are presented.

Sensor Webs
Delin, Kevin; Shannon Jackson; Raphael Some, Caltech.
NASA Tech Briefs, Oct 1999

Sensor webs are developmental collections of sensor pods that can be scattered over land or water areas or other regions of interest to gather data on spatial and temporal patterns of relatively slowly changing physical, chemical, or biological phenomena in those regions. Each sensor pod would be a node in a data-gathering/data-communication network that would span a region of interest. Each sensor pod will contain two modules: a transducer module that would interact with the environment to gather the desired data, and a communication module. The sensor webs will offer the advantages of flexible deployment, low power consumption, and low cost.

A Shore-Based Lidar for Coastal Seawater Monitoring
Maslov, D.V., and V.V. Fadeev (Moscow State Univ., Russia); A.I. Lyashenko (Inst. "Polyus", Moscow, Russia).
The 4th EARSeL Workshop: Lidar Remote Sensing of Land and Sea, 16-17 June 2000, Dresden.

This paper presents a description of a shore-based lidar system for continuous express monitoring of pollution transport in coastal seawater based on the results of field tests in the region of the Blue Bay of the Black Sea, near Gelendzhik. Echo-signals were obtained with excitation wavelengths of 532, 355 and 266 nm (2nd, 3rd, and 4th harmonics of a YAG:Nd laser). The dependencies of an echo-signal (in this case water Raman scattering) on the sensing distance of the laser beam were investigated. The results obtained appear to correlate well with the theory of laser remote sensing under large incidence angles, in which wind waves are taken into account. Laser radiation with 532 nm wavelength at 10 Hz repetition rate, with 10 ns pulse duration and 10 mJ pulse energy was used in the experiments. The sensing distance was up to 100 m at a sensing angle of ~80°, with a possibility of increasing the sensing distance up to 0.5-1 km. This device can be used for monitoring bays similar to the Blue Bay or other vitally important areas.
Available at http://las.physik.uni-oldenburg.de/projekte/earsel/4th_workshop.html

A Simple, Inexpensive, and Rapid Method to Determine Toxicity Using a Bacterial Indicator Organism
Botsford, James L. New Mexico State Univ., Las Cruces, NM.
The 2000 Conference on Hazardous Waste Research: Environmental Challenges and Solutions to Resource Development, Production, and Use, 23-25 May 2000, Denver, Colorado
Great Plains/Rocky Mountain Hazardous Substance Research Center, Manhattan, KS.

During this research, more than 200 chemicals have been assayed and the results compared with good agreement with the results from 22 other assays. The method uses the bacterium Rhizobium meliloti, the bacterium that grows symbiotically with alfalfa and fixes nitrogen for the plant. The bacterium can reduce a thiazole tetrazolium dye, MTT, very readily and toxic chemicals inhibit the reduction of the dye. Large amounts of toxin inhibit the reduction severely; smaller amounts have a lesser effect, so the test is quantitative. A spectrophotometer is used to estimate reduction of the dye. Divalent cations inhibit reduction of the dye, but this effect can be eliminated by the addition of small amounts of EDTA. The test is simple, inexpensive, and quick. The bacteria can be grown for almost nothing and the chemicals used are inexpensive and readily available. The test requires less than an hour to carry out the reactions, plot the results, and calculate the toxicity of the sample. Any laboratory able to grow bacteria should be able to carry out the assay readily.
http://www.ecc.ksu.edu/HSRC/Abstracts00.html

Simple Optical Computing Device for Chemical Analysis
Soyemi, Olusola O. (Univ. of South Carolina); Lixia Zhang; DeLyle Eastwood; Hongli Li; Paul J. Gemperline (East Carolina Univ.); Michael L. Myrick (Univ. of South Carolina).
Functional Integration of Opto-Electro-Mechanical Devices and Systems.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 4284, p 17-28, 2001

Multivariate optical computing (MOC) devices utilize special optical interference coatings known as multivariate optical elements (MOEs) that are encoded with pre-determined spectroscopic patterns to selectively quantify a chemical species of interest in the presence of other interfering species. The researchers present a T-format prototype of the first optical computing device based on a multilayer

MOE consisting of alternating layers of two metal oxide films (Nb_2O_5 and SiO_2) on a BK-7 glass substrate. This paper describes the design and testing of the device.

Simultaneous Determination of Low Parts-per-Billion Level Pb and As in Waters Using Energy-Dispersive X-Ray Fluorescence Spectrometry
Hettipathirana, T.D.; L.H. Smith; K. Norrish, Separation Science and Spectrochemical Analysis Group, Remediation of Contaminated Environments, CSIRO Land and Water, Glen Osmond, SA, Australia.
Applied Spectroscopy, Vol 55 No 3, Mar 2001

A simple method for the simultaneous determination of low parts-per-billion levels of As and Pb in waters pre-concentrates analytes by adsorbing them onto hydrous ferric hydroxide (HFO) impregnated into the 13 mm diameter area at the center of 32 mm diameter circular disks cut from Whatman filter papers. The adsorbed analytes are determined via thin-layer, energy-dispersive X-ray fluorescence spectrometry. The method was validated by analyzing various riverine and seawater certified reference materials for As. This paper presents the adsorption characteristics of Pb, As(III), As(V), Se(IV), Se(VI), and Hg onto the HFO-impregnated disks, inter-species adsorption effects, and the use of the standard addition method to compensate for matrix effects.

Simultaneous Determination of Trace Amounts of Free Cyanide and Thiocyanate by a Stopped-Flow Spectrophotometric Method
Sun, Bianting; B.N. Noller.
Water Research, Vol 32 No 12, p 3698-3704, 1998

Simultaneous determination of free cyanide and thiocyanate was investigated using a stopped-flow spectrophotometric method. 1,3-dimethylbarbituric acid/isonicotinic acid at pH 5.2 was used as the color reagent for both cyanide and thiocyanate determinations.

Spark-Induced Breakdown Spectroscopy (SIBS): A New Technique for Monitoring Heavy Metals
Hunter, A.J.R.; S.J. Davis; L.G. Piper; K.W. Holtzclaw; M.E. Fraser, Physical Sciences Inc., Andover, MA.
Applied Spectroscopy, Vol 54 No 4, 2000

This paper presents the development and testing of a real-time monitoring technique for heavy metal aerosols and particulates in air based on spark-induced breakdown spectroscopy (SIBS). The technique is based on temporally resolved atomic emission resulting from excitation of the aerosol-laden air sample in a high energy electrically generated spark. A complete prototype monitor comprised of spark power supply, sample chamber, bandpass-filtered radiometric detector, and computer for real-time data acquisition and display has been assembled, calibrated, and tested. The lower limits of detection for lead and chromium are 10 mg/m^3. The monitor has been successfully applied as a continuous emissions monitor for lead and chromium in a simulated combustion flue gas at a joint EPA/DOE test for fugitive chromium emissions above a hard chrome plating tank and for airborne particulate lead at an indoor firing range.

Speciation Analysis: the Automated Speciation Analyser
Slaets, Sofie, Ph.D. dissertation, Universitaire Instelling Antwerpen (Belgium).
University Microfilm, UMI Pub No AAT 3014317. ISBN: 0-493-24372-0. 172 pp, 2000

As a collaboration between three research groups, an automated speciation analyzer (ASA) has been developed within a project of the European Community with the objective to develop a cheap, simple, and easy to handle instrument for routine speciation analysis of organometals. The ASA consists of an isothermal GC, housing a multicapillary (MC) column, coupled to a microwave induced plasma emission detector. It is equipped with a purge and trap injection (PTI) system. After the installation of the first prototype of the ASA in our laboratory, this instrument was optimized for the speciation analysis of organomercury and organotin compounds, which led to an analytical technique for the determination of methylmercury and inorganic mercury that is exploitable on a routine basis. Due to the low sensitivity obtained for methyltin compounds, further investigations need to be performed to make the ASA applicable for routine analysis of these particular compounds. The second prototype of the injection and separation unit of the ASA was coupled to an inductively coupled plasma mass spectrometer and applied to the determination of organomercury compounds. This coupling results in a fast and sensitive analysis techniques for the speciation of methylmercury and inorganic mercury.

Speciation of Aromatic Compounds with Excitation-Emission Matrix Measurements
Pepper, Jane W. (Tufts Univ.); Yu-Min Chen; Andrew O. Wright; Jonathan E. Kenny.
Internal Standardization and Calibration Architectures for Chemical Sensors.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 3856, p 252-260, 1999

A multiple channel laser-induced fluorescence (LIF) system is an effective tool for in situ monitoring of polyaromatic hydrocarbons (PAHs). The system delivers ten laser beams to a samples and simultaneously detects the fluorescence signals from the individual channels, generating an excitation-emission matrix (EEM) of the sample. In a preliminary study of eleven target aromatic compounds to determine the capability of the technique for speciation, nine were successfully identified individually, while two spectroscopically very similar compounds, naphthalene and 2-methylnaphthalene, could be differentiated from the other nine but not from each other. When the technique can correctly identify the presence of the class, e.g., naphthalenes, instead of individual components, the quantitative results for the class must be interpreted accordingly.

Spectral Pattern Recognition: the Methodology
Siddiqui, Khalid J. (SUNY/Fredonia); DeLyle Eastwood (Air Force Inst. of Technology); Yi-Hsin Liu (Univ. of Nebraska/Omaha).
Pattern Recognition, Chemometrics, and Imaging for Optical Environmental Monitoring.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 3854, p 84-97, 1999

Using spectral data, spectral pattern recognition (SPR) systems have found applications in chemometric systems such as gas chromatography and fluorescence spectroscopy for noninvasively examining the spectroscopic data for environmental monitoring. SPR approaches make no a priori assumption regarding the structure of the spectra; however, a majority of these systems rely on human judgement for parameter selection and classification.

A Study of Gas-Phase Mercury Speciation Using Detailed Chemical Kinetics
Edwards, Jack R., (North Carolina State Univ., Raleigh); Ravi K. Srivastava (U.S. EPA, Research Triangle Park, NC), James D. Kilgroe.
Journal of the Air & Waste Management Association, Vol 51 No 6, Jun 2001

Mercury speciation in combustion-generated flue gas was modeled using a detailed chemical mechanism consisting of 60 reactions and 21 species. This speciation model accounts for the chlorination and oxidation of key flue-gas components, including elemental mercury. The performance of the model was affected by temperature. This paper attempts to develop a relatively detailed understanding of gas-phase transformations of Hg species resulting from chlorination.

Surface Acoustic Wave Continuous Emissions Monitor for Total Mercury
Caron, Joshua J., Sensor Research and Development Corp., Orono, ME.
Industry Partnerships for Environmental Science and Technology Conference, 2000.
U.S. DOE, National Energy Technology Laboratory. 6 pp, 2000

Microwave acoustic devices, such as thickness shear mode (TSM) resonators and surface acoustic wave (SAW) delay lines, offer a promising new approach to detection of environmental pollutants. By incorporating a thin film that selectively chemically sorbs a target measurand (e.g. mercury), electrical and mechanical changes in the thin film are manifested as alterations in the resonant frequency of the acoustic wave device. Thus, by coating a SAW delay line with a gold film which efficiently sorbs mercury, a highly sensitive mercury vapor sensor can be realized. The overall objective of this work has been to demonstrate the feasibility of a SAW mercury vapor sensor and to incorporate the technology into a prototype CEM for use in a hazardous waste incinerator.
http://www.fetc.doe.gov/publications/proceedings/00/ind_part00/em6-4.pdf

A Survey of U.S. Commercial Environmental and Industrial Optical Sensor Environmental Monitoring Equipment Manufacturers
U.S. DOE, Federal Energy Technology Center, Morgantown, WV.
DE--FC21-94MC31179--4, 62 pp, Oct 1998
This manufacturers survey includes open-path and extractive Fourier transform infrared (FTIR) spectrometers, Raman laser systems, fiber optic sensors, ultraviolet open-path sensors, lidar systems, thermal imaging or sensing, and open-path and in situ diode lasers.
http://www.osti.gov/bridge/product.biblio.jsp?osti_id=1317

Synchronous Scanning Luminescence: Methods to Detect Pesticides and Explosives
Hyfantis, G.J. (Environmental Systems Corp.); M.S. Teglas; T.P. Finnegan; P.J. Mulligan; W. Watts.
Environmental Monitoring and Remediation Technologies II.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 3853, p 110-115, 1999

The Synchronous Scanning Luminoscope (SSL) is a field-portable, synchronous luminescence spectrofluorometer that was developed for on-site analysis of contaminated soil and ground water. Quantitative analysis of pesticides and explosives using phosphorescence and fluorescence techniques allow for rapid field assessments for pesticides and explosives to the parts per billion (ppb) range.

Synchrotron-Based Spectroscopic Studies of Metal Species in Solid Phases: the Case of Arsenic
Foster, A.L., U.S. Geological Survey, Menlo Park, CA.
USGS Workshop on Arsenic in the Environment, 21-22 February 2001, Denver, CO

The production of high-energy (1 KeV to 40 KeV) x-radiation at synchrotron laboratories around the world has enabled the spectroscopic analysis of core level electronic transitions and electronic scattering processes in trace (< 1000 ppm) metal and metalloid atoms as they are found in heterogeneous natural materials (e.g., soils, sediments, plants, and microbial mats). Environmental geochemists interested in arsenic (As) have found this information of particular interest, because the oxidation state(s) and chemical coordination of As can be studied in materials that have been difficult to study using other techniques. The primary technique used for the past 10 years has been bulk X-ray absorption fine structure spectroscopy (XAFS), but this method is becoming increasingly augmented/supplanted by microbeam XAFS and X-ray fluorescence techniques. X-ray absorption fine structure (XAFS) spectroscopy has characteristics that make it the technique of choice for the analysis of environmentally-relevant solid materials: element specificity; low detection limits (relative to lab-based X-ray fluorescence and electron microprobe techniques); analysis under ambient or sample-specific conditions; direct information about As oxidation state; and direct information about As coordination environment. An XAFS spectrum is collected by directing a beam of X-rays (finely collimated, or just unfocused white light) on a sample. The X-ray beam can vary in size from 10 microns (µm) to 20 millimeters wide. The former technique, using very small, finely collimated and focused X-ray beams to analyze small samples, is called spectromicroscopy, and is used to analyze very small samples or to obtain spatially-resolved XAFS information from a larger sample. Data collection for both micro- and macrobeam XAFS is similar.

A TDR System for Subsurface Pollutants Detection (I): Design & Modeling
Said, R.A. (United Arab Emirates Univ., A-Alin, United Arab Emirates); N.K. AlShawawreh; A.M.O. Mohamed.
Proceedings of the 2nd International Symposium and Workshop on Time Domain Reflectometry for Innovative Geotechnical Applications, 5-7 September 2001, Northwestern University, Evanston, IL. Infrastructure Technology Institute, Northwestern University, Evanston, IL. ISBN: 0-9712631-0-8.

A TDR system developed for in situ detection of subsurface pollutants is simple to implement using a typical pulse generator, with a repetition rate of 125 MHz and rinse/fall times of 2ns, and a conducting probe connected via a transmission line (coaxial cable). The system probe is designed using antenna theory to match its input impedance to that of the used transmission line connecting the pulse generator and the probe. The pollutant concentration in soil is detected by measuring and analyzing the variation of soil-pollutant dielectric properties as a function of concentration of the pollutant in the soil.
http://www.iti.northwestern.edu/tdr/tdr2001/proceedings/tdr2001.zip [Note: This is a very large file!]

A TDR System for Subsurface Pollutants Detection (II): Application & Analysis
Said, R.A. (United Arab Emirates Univ., A-Alin, United Arab Emirates); N.K. AlShawawreh; A.M.O. Mohamed.
Proceedings of the 2nd International Symposium and Workshop on Time Domain Reflectometry for Innovative Geotechnical Applications, 5-7 September 2001, Northwestern University, Evanston, IL. Infrastructure Technology Institute, Northwestern University, Evanston, IL. ISBN: 0-9712631-0-8.

A TDR based system for the in situ detection of subsurface pollutants extracts the concentration of pollutant species by measuring and analyzing the variation of soil-pollutant dielectric properties as a

function of concentration of the pollutant in the soil. To quantify measured concentration of pollutant in subsurface soil, a calibration curve is generated from modeling the TDR system by electrical parameters using transmission line theory. The modeled system is simulated and the model parameters were optimized via the determined experimental data. Based on the optimized parameters (resistance and capacitance), a calibration curve is produced, thus enabling the extraction of the pollutant concentration.
http://www.iti.northwestern.edu/tdr/tdr2001/proceedings/tdr2001.zip [Note: This is a very large file!]

Temporal Gating for the Optimization of Laser-Induced Breakdown Spectroscopy Detection and Analysis of Toxic Metals
Fisher, B.T.; H.A. Johnsen; S.G. Buckley; D.W. Hahn, Univ. of Florida, Dept. of Mechanical Engineering, Gainesville.
Applied Spectroscopy, Vol 55 No 10, Oct 2001

Optimal temporal gating for laser-induced breakdown spectroscopy (LIBS) analysis was investigated for a group of toxic metals: arsenic, beryllium, cadmium, chromium, lead, and mercury. The differing rates of decay between the continuum plasma emission and the atomic emission were used to maximize the signal-to-noise ratio of the atomic emission lines for the metal species. The researchers concluded that the relatively short delay time of 12 ms was optimal for the detection of arsenic, beryllium, cadmium, and mercury, with a longer delay time of 50 ms for chromium and lead. The use of long detector gate-widths compensates for the reduced atomic emission intensity at relatively long delay times. The paper notes the estimated detection limits for the six metal species based on the optimized temporal gating and ensemble averaging of multiple laser pulses.

Test Kit/Spectrometer for the Analysis of Petroleum Substances Using Friedel-Crafts Colorimetry
Hanby, John D. (Hanby Environmental Laboratory Procedures, Inc.); Alan D. Hewitt (U.S. Army Cold Regions Research and Engineering Lab.); Ernest E. Lory (Naval Facilities Engineering Service Ctr.).
Water, Ground, and Air Pollution Monitoring and Remediation.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 4199, p 8-18, 2001

Laboratory and field results of the testing of a new, visible-range spectrometry utilizing the robust signals produced by Friedel-Crafts reaction compounds demonstrate the utility of a rapid, portable, and sensitive method for on-site analysis of petroleum substances in soil and water samples. Specific field protocols for sampling and handling soils for gasoline range organics and diesel range organics were established for the field sampling. Test kit colorimetric results by visual and spectrometric methods were compared with reference laboratory results and CRREL analyses.

Theory and Laboratory Study of a Tall Passive Chamber for Measuring Gas Fluxes at Soil Surface
Gao, Frank F. (Delaware Dept. of Natural Resources and Environmental Control, Dover); Yan Jin (Dept. of Soil and Plant Sciences, Univ. of Delaware, Newark); Scott. R. Yates (U.S. Dept. of Agriculture Salinity Laboratory, Riverside, CA), Sharon Papiernik; Michael A. Anderson (Dept. of Environmental Sciences, Univ. of California, Riverside), Marylynn V. Yates.
Journal of the Air & Waste Management Association, Vol 51 No 1, Jan 2001

The study described here proposes a tall passive chamber and its flux model for measuring gas emissions from soil and water to the atmosphere. The height of the chamber should avoid a common problem associated with shallow passive chambers of concentration buildup in the headspace.

Laboratory experiments have shown that the tall chamber is a likely and applicable tool for emission measurement at the soil surface.

Three Dimensional Fluorescence Spectroscopy: a Quick, Effective, and Sensitive Screening Tool for Detecting the Presence and Source of Organic Wastes in Water
Prewett, Jerry L.; James W. Duley, Dept. of Natural Resources, Div. of Geology and Land Survey, Rolla, MO.
Association of Engineering Geologists & American Institute of Professional Geologists 2001 Joint Annual Meeting Abstracts. AEG News, Vol 44 No 4, p 72, Jul 2001

The screening techniques developed by the Department of Natural Resources use characteristic signatures for different waste types based on fluorescence excitation/emission maxima. Water samples collected from sanitary landfill leachate collection systems, landfill gas collection systems, wastewater treatment systems, and other organic sources were analyzed using a Hitachi Model F-4500 fluorescence spectrophotometer. Fluorescence intensity was contoured on excitation/emission plots to produce a three-dimensional map of fluorescence. Specific ranges of excitation and emission wavelengths were selected from broad spectrofluorometric scans to isolate areas of the contour plot that show maximum effects from organic wastes. Numerous scans of known waste types then underwent comparative analysis to look for similarities and differences. The result was a surprisingly accurate tool that could determine if a water source contained significant amounts of waste, and of what general type. Ongoing use of these techniques has proven to be quick, effective, and sensitive in determining presence and general type of waste contained in a water source, and has been used to minimize the number of wet chemistry analyses required for a study area.

Towards Faster and More Reliable Methods for the Speciation Analysis of Organolead Compounds in Environmental Samples
Heisterkamp, Monika, Ph.D. dissertation, Universitaire Instelling Antwerpen (Belgium).
University Microfilm, UMI Pub No AAT 9988245. ISBN: 0-599-94997-X. 190 pp, 2000

Organolead compounds, once used as anti-knocking agents in leaded gasoline, are among the environmentally unsafe products to be banned from the market due to the realization of the toxic effects of organolead compounds on the environment and human health. This research was designed to assist with simplifying an analytical procedure for the speciation analysis of organolead compounds using hyphenated techniques based on gas chromatography (GC). Sample preparation could be speeded significantly using derivatization methods based on in situ alkylation, meaning derivatization directly in the water phase. The use of alkylborates allows a simplified and simultaneous separation of the organolead species from the matrix, derivatization, and extraction within a one-step procedure. Another time-consuming step in speciation analysis using hyphenated techniques is the separation of the species. Application of multi-capillary columns in GC can drastically reduce the time necessary for a chromatographic run. Very narrow peaks are generated requiring especially fast detection systems. Inductively coupled plasma time-of-flight mass spectrometry (ICP TOFMS) offers distinctive capabilities as regards detector speed and was therefore coupled to GC. The system was optimized to speed GC separation of the different organolead species. Quality assurance of the optimized analytical methods involved participation in a certification exercise that resulted in the availability of a new certified reference material (CRM).

Toxicity Screening of Benzene, Toluene, Ethylbenzene and Xylene (BTEX) Hydrocarbons in Groundwater at Sour-Gas Plants
Headley, J.V.; S. Goudey; D. Birkholz; L.R. Linton; L.C. Dickson, National Water Research Inst., Saskatoon, Sask., Canada.
Canadian Water Resources Journal, Vol 26 No 3, p 345-358, Fall 2001

A toxicity-based approach was used to assess the quality of ground-water samples collected from gas plants in western Canada for levels of BTEX as indicator compounds for monitoring the degree of bioremediation and bioventing at the sites. In general, the concentration of BTEX was a good indicator of the toxicity of the ground water--approximately 5% of the samples were observed to be toxic, although the concentrations of BTEX were low (less than 1 µg/L). Based on the laboratory results, the remediation of BTEX in ground water at the sour-gas plants is expected to correlate well with the removal of acute toxicity to selected aquatic organisms. Toxicity tests included bacterial luminescence (Microtox®), daphnia mortality, fathead minnow mortality, and lettuce seedling emergence.

Tracking Specific Polychlorophenol-Degrading Bacteria and Genes from Contaminated Soil Using Gene Probes, PCR and Microarrays
Laine, M.; J. Klappenbach; E. Spirina; et al.
Proceedings of the Ninth International Symposium on Microbial Ecology, 26-31 August 2001, Amsterdam, The Netherlands. Paper No. P.23.076, 2001

No abstract available.

Transfer of Heavy Metal Resistance Marker Between Gram-Positive and Gram-Negative Bacteria of Activated Sludge
Dong, Q.; D. Springael; J. Schoters; L. Diels; M. Mergeay, Vlaamse Instelling voor Technologisch Onderzoek (VITO), Environmental Technology, Mol, Belgium.
MAREP International Conference on Marker/Reporter Genes in Microbial Ecology, 14-17 June 1997, Stockholm, Sweden. Extended Abstracts.

In the monitoring of genetically modified micro-organisms (GMMs) disseminated to the environment, the use of bacterial antibiotic resistance character as a genetic marker may be undesirable. The authors here consider as a monitoring alternative the substitution of bacterial antibiotic resistance markers by bacterial heavy metal resistance character. Within a study to transfer heavy metal resistance genes in an activated sludge ecosystem, they have investigated the transfer and expressivity of ncc-nre loci, a nickel, cobalt, and cadmium resistance gene cluster, within different phyla of *Eubacteria*.
Extended abstracts available at http://www.sh.se/marep/program.html

Tri-Service Characterization and Analysis Penetrometer System (SCAPS) Validation of the Hydrosparge Volatile Organic Compound Sensor
Davis, W.M., et al., U.S. Army Engineer Research and Development Center, Vicksburg, MS.
Report No: ERDC/EL TR-01-9, 72 pp, Jun 2001

The Hydrosparge VOC sensor was developed for the Tri-Services Site Characterization and Analysis Penetrometer System (SCAPS) program to provide in situ VOC detection in ground waters. The system consists of a direct push well for groundwater access, an in situ sparge module, and a direct-

sampling ion trop mass spectrometer. The Hydrosparge VOC sensor was tested at three geographically different sites across the country. The results obtained with the SCAPS in situ technique indicate a strong linear relationship with EPA methods with regression coefficients ranging between 0.63 and 0.88 and the slope of the regression line between 1.1 and 1.2. The SCAPS Hydrosparge VOC sensor has been demonstrated to reduce the time and cost required to characterize sites by directing the placement of a reduced number of conventional monitoring wells.
http://www.wes.army.mil/el/elpubs/genrep.html

Ultratrace Determination of Arsenic, Selenium and Antimony by Hydride Generation with Laser-Induced Fluorescence and Laser-Enhanced Ionization Detection Methods
Pacquette, Hazel Lawrence, Ph.D. dissertation, Univ. of Iowa.
University Microfilm, UMI Pub No AAT 99961490-493-04873-1. 117 pp, 2000

In spite of their low concentration, arsenic (As), selenium, and antimony (Sb) play important roles in the environment and on the health of all living organisms.
Presented in this thesis are studies in the development of laser-induced fluorescence (LIF) techniques and hydride generation (HG) sample introduction combined with LIF and laser-enhanced ionization (LEI) detection. These techniques provide exceptional sensitivity and low spectral interferences. In addition, HG has the ability to distinguish oxidation states of As and Se, which determines the toxicity of these elements. Spectroscopic measurements of As and Se are complicated by the fact that their primary absorption wavelengths occur below 200 nm, which is a difficult region to access with conventional laser systems. However, through the use of stimulated Raman scattering (SRS), it is straightforward to generate laser radiation in the far ultraviolet (UV) spectral region. Studies were performed using atomizers such as the inductively coupled plasma, electrothermal atomizers, and an H2/Ar flame. Although all the techniques are sensitive, the highest sensitivity for As, Se, and Sb was achieved by using continuous flow HG-LIF and HG-LEI. The limits of detection are 200 fg ml^{-1}, 90 fg ml^{-1} and 300 fg ml^{-1} for As, Se and Sb, respectively, using HG-LIF and 50 pg ml^{-1} and 2 pg ml^{-2} for As and Se, respectively, using HG-LEI approaches. Measurements performed using continuous flow HG-ETA-LIF with in situ trapping resulted in LODs of 1 pg ml^{-1} and 20 pg ml^{-1} for As and Se, respectively. All of these techniques are linear to at least 10 rig ml^{-1} for each element. Reliable chemical speciation has also been demonstrated for As(III/V) and Se(IV/VI) species by these approaches. Regression parameters obtained from the calibration plots demonstrate that the HG approaches are selective and provide quantitative recoveries of individual Se and As species at low ppt levels.

Understanding and Applying Open-Path Optical Sensing Data
Virag, Peter (Roy F. Weston Inc., West Chester, PA); Robert J. Kricks (RJK Consulting).
Environmental Monitoring and Remediation Technologies Conference, 2-5 November 1998, Boston, MA.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 3534, p 187-193, 1999

This paper will review previous open-path monitoring programs and their success in applying the data collected. It will also look at how open-path data are being used currently, some previous pitfalls in data use, alternate methods of data interpretation, and how open-path data can be practically applied.

The Use of GFP and *luc* to Monitor Specific Gene-Expression in Plant Pathogenic and Soil Bacteria
Romantschuk, Martin, Dept. of Biosciences, Univ. of Helsinki, Finland.
MAREP: Marker/Reporter Genes in Microbial Ecology, Second International Conference, 4-7 December 1999, Stockholm, Sweden. Book of Abstracts, p 14, 1999

Constructs were made to enable visualization and measurement of gene expression in situ in soil and plant environments. Three different promoters with known induction characteristics were linked to either the wild type *gfp* gene or to a *luc* gene. Constuct 1 contained the promoter of the *hrp*A gene linked to the wt *gfp* gene. Constructs 2a and 2b contained heavy metal inducible promoters (mercury and arsenite) linked to a bacterial luminescence gene (*luc*). Both types of constructs can easily be visualized with CCD camera setups, luminometers, or fluorometers, etc.
Book of abstracts available at http://www.sh.se/marep/congr2test.html

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The Use of GFP as a Reporter with Weak Bacterial Promoters and Comparison of the Results with Firefly Luciferase
Virta, Marko; Janne Lehtinen; Matti Karp, Univ. of Turku, Turku, Finland.
MAREP: Marker/Reporter Genes in Microbial Ecology, Second International Conference, 4-7 December 1999, Stockholm, Sweden. Book of Abstracts, p 10, 1999

The use of green fluorescent protein (GFP) as a reporter protein has been increasing rapidly in recent years. GFP has some properties that make the it an attractive choice for a reporter gene: it does not need any substrate, since it not an enzyme, nor does it need any cofactors. One problem with GFP is the background fluorescence emitted by cells when GFP is exited by illumination. The background problem should be most severe in cases when the expression of reporter gene is relatively low. The researchers investigated the usability of GFP as reporter gene with weak promoters. The results were compared with the results obtained with firefly luciferase (*luc*FF), which has no background in most cells. In constructing the plasmids used in measurement, first firefly luciferase gene was introduced to pEGFP plasmid downstream from the GFP gene. The resulting plasmid had GFP and *luc*FF genes in a dicistronic operon under the control of lac promoter/operator. To test the properties of GFP with test weak promoters, *lac* promoter/operator was changed to *ars* or *mer* promoter/operator. Plasmids were transferred to *Escherichia coli* XL-1 Blue strain. Uninduced fluorescence was similar to the fluorescence obtained with pUC19 (control plasmid without GFP and *luc*FF). The blank fluorescence of *lac* promoter without glucose was considerably higher, over 20 fold compared to others. The maximum fluorescence values with mer and ars promoters were just under 500 RFU, whereas the plasmid with *lac* promoter resulted in higher fluorescence, 1212 RFU with glucose and 6089 RFU without glucose. The difference in sensitivity of GFP and luciferase was considerable.
Book of abstracts available at http://www.sh.se/marep/congr2test.html

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Use of Molecular Monitoring Tools in Bioremediation of Chlorinated Solvents
Krooneman, J.; J.J. Van Der Waarde; A.W. Van Der Werf; M.J.C. Henssen.
Proceedings of the Ninth International Symposium on Microbial Ecology, 26-31 August 2001, Amsterdam, The Netherlands. Paper No. Tu.074, 2001

No abstract available.

Use of TDR to Monitor Changes in Ground Water Level and Crude Oil Thickness
O'Connor, Kevin M. (GeoTDR, Inc., Apple Valley, MN); Geoffrey N. Delin (U.S. Geological Survey, Mounds View, MN).
Proceedings of the 2nd International Symposium and Workshop on Time Domain Reflectometry for Innovative Geotechnical Applications, 5-7 September 2001, Northwestern University, Evanston, IL. Infrastructure Technology Institute, Northwestern University, Evanston, IL. ISBN: 0-9712631-0-8.

Measurements were made in a well screened in a residual pool of crude oil near Bemidji, MN, to evaluate the use of TDR to monitor variations in oil thickness and ground-water levels. The pool is the result of a crude oil pipeline break in 1979 and rests on the water table. The U.S. Geological Survey maintains the site as a research facility and over 250 monitoring wells have been installed to characterize subsurface conditions. Data are acquired automatically using TDR by interrogating an air-dielectric coaxial cable installed in one well. Independent measurements are made manually with an oil-interface probe in several adjacent wells. Both types of measurements indicate a seasonal variation in apparent oil thickness within the wells varying from a minimum of 365 mm in June 1998 to a maximum of 655 mm in October 1998. This research demonstrates that it is now possible to continuously measure changes in the apparent thickness of light non-aqueous phase liquids (LNAPLs) using TDR, which may prove to be a useful tool in evaluating remediation efforts in contaminated aquifers.
http://www.iti.northwestern.edu/tdr/tdr2001/proceedings/tdr2001.zip [Note: This is a very large file!]

Use of the *lacZ* Reporter Gene to Assess the Fate and Specific Activity of *Pseudomonas fluorescens* Inoculants in the Field
Van Elsas, Jan Dirk; Leo Simon Van Overbeek, IPO-DLO, Wageningen, The Netherlands.
MAREP International Conference on Marker/Reporter Genes in Microbial Ecology, 14-17 June 1997, Stockholm, Sweden. Extended Abstracts.

To assess both the survival and the activity of inoculant bacteria, specific markers are needed that allow the enumeration of the introduced populations over time, as well as their activities in response to soil conditions. The researchers have used l*acZ*-based promoterless reporters located on suitable transposon Tn5-based insertion vectors in a rifampicin-resistant derivative of the potential inoculant strain *Pseudomonas fluorescens* R2f, to provide both selectable markers (nptII) for detection in soil and to identify the in situ inoculant gene expression controlled by regulatory regions identified by the reporter gene insertions.
Extended abstracts available at http://www.sh.se/marep/program.html

Using Geophysics to Map the Shallow Subsurface: Not Your Normal "Boring" Site
Blaske, Allan R.; Roger Noyce, STS Consultants, Lansing, MI.
Association of Engineering Geologists & American Institute of Professional Geologists 2001 Joint Annual Meeting Abstracts. AEG News, Vol 44 No 4, p 56, Jul 2001

Releases from a plating facility in southwest lower Michigan resulted in metals and solvents contamination of shallow ground water and surface water. Affected ground water has migrated approximately 2,500 feet from the source, and vents to surface water along the length of the plume. Early investigation of the site indicated that the soil consists of sand overlying a thin layer of clay, which was interpreted to be continuous beneath the site. Ground water is present within the upper five feet of the site, and is present both above and below the clay, which is present within the upper 15 feet. Geology of the site consists of glacial lacustrine sand with interbedded clay, overlain by delta deposits. These deposits were cut, and the river valley filled with fluvial deposits of sand, gravel, silt, clay, and peat. The integrity of the underlying clay layer was of paramount importance to STS, to prevent contamination of deeper levels of the aquifer through careless sampling techniques (i.e., drilling through the clay and allowing vertical migration). STS used geophysical techniques to map the subsurface and create a geologic model. Ground conductivity was measured using an EM-34-3XL, to map the distribution of conductive contaminants; the extent, depth, and thickness of the subsurface clay was mapped using an electrical resistivity survey; and the depth to the top of the clay was measured using seismic refraction techniques. Detailed geophysical mapping of the geology indicated that the site was more complicated than originally envisioned. Using geophysics, a subsurface model was prepared with greater detail (and lower cost) than could have been possible using conventional boring and sampling techniques.

Using the DNA of Soil to Monitor Progress of Remediation
Site Remediation Markets, No 29, Jan 2001

Engineers at Purdue University are using genetics to measure the progress of cleanup at petroleum-contaminated sites. Contaminated soil is screened for genes that reveal the presence of an enzyme, catechol 2,3-dioxygenase, that is produced by pollution-degrading bacteria and is an indicator that bacteria are most likely cleaning the soil. Concentrations of the bacteria can be measured to assess progress in remediation. The new method can test soil at contaminated sites in several hours, as opposed to conventional methods that require several days in a laboratory. A commercially available kit can be used to extract DNA samples from the soil, and then a search can be made for genes that reveal the presence of the enzyme. A DNA primer has been designed to detect only catechol 2,3-dioxygenase. The method has been used successfully in bench and field-scale models. Commercial availability, according to the Purdue engineers, will depend on demand.

The Validation of Passive Monitors to Assess Long Term and Low Level Exposures to Formaldehyde
DiNardi, S. (Univ. of Massachusetts at Amherst); D. Slavin, R. Woolrich, D. Burnside (Naval Submarine Medical Research Lab., Groton, CT); J. Callahan (Naval Research Lab., Washington, DC).
American Industrial Hygiene Conference & Exposition, 2-7 June 2001, New Orleans, Louisiana. #129

In unique closed environments such as those found on submarines, low-level airborne chemical exposures may occur if trace chemical compounds accumulate through material off-gassing, human metabolism, machinery operation, cooking, maintenance, and chemical reactions of parent compounds in electrostatic precipitators and other equipment. This paper describes a laboratory validation program to evaluate the use of Assay Technology formaldehyde passive samplers at concentrations from 10 to 40 ppb over 28 days.

Vapor Detection of Polyaromatic Compounds Using Laser-Induced Fluorescence
Chi, Z.; B.M. Cullum; J. Mobley; G. H. Miller; T. Vo-Dinh, Oak Ridge National Lab.
Water, Ground, and Air Pollution Monitoring and Remediation, 6-7 November 2000.
Proceedings of SPIE--The International Society for Optical Engineering, Vol 4199, p 173-179, 2001

Anthracene and pyrene vapors at different elevated temperatures (from 150 to 650°C) excited with the 337 nm line of a nitrogen laser produce fluorescence spectra whose recognizable properties include spectral intensity, spectral bandwidth, and spectral shift. The PAH fluorescence spectral bandwidths become very broad as the temperature increases, which broadening is mainly due to thermal vibrational sequence congestion. The fluorescence intensity of pyrene vapor increases with increasing temperature due to the increase of the pyrene vapor absorption cross section at 337 nm.