NanoAffix Science, LLC

NIEHS Virtual Technology Fair

Real-Time Portable Lead Tester for Improving Access to Safe Drinking Water

James Hill, Ph.D.
Chief Science Officer
October 28, 2024

NANOAFFIX
Accurate Affordable Analysis

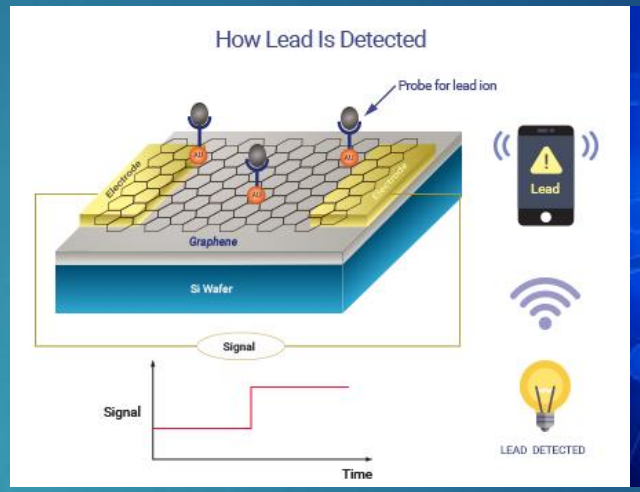
Problem/Solution

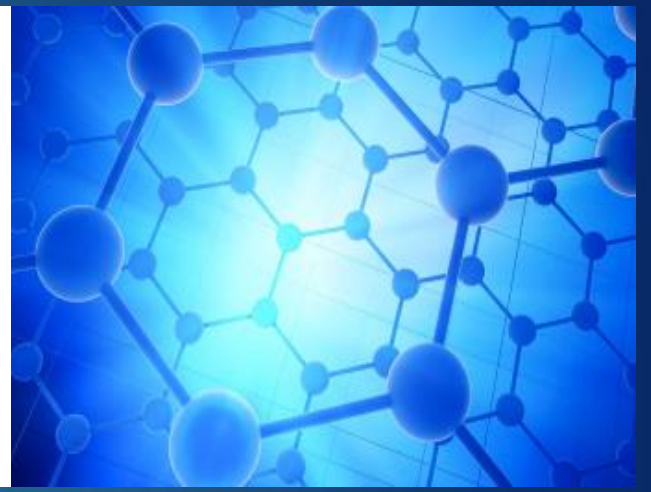
- Problem: Toxic contaminants in drinking water cause acute and chronic organ damage
  - Lead (Pb) in drinking water causes brain damage, especially in children
  - Current testing methods are either inaccurate (paper test strips) or expensive and slow (ICP)
  - EPA Maximum Contaminant Level (MCL) is 15 ppb Pb
  - EPA MCLG is 0 ppb Pb
- Solution: NanoAffix has developed a portable water test kit that provides results in minutes
  - Faster, better, and less expensive than other portable analyzers
  - Enables increased frequency of testing

NanoAquaSense

Technology

- NanoAquaSense
  - Media – Water
  - Target Contaminant – Lead (Pb^{2+})

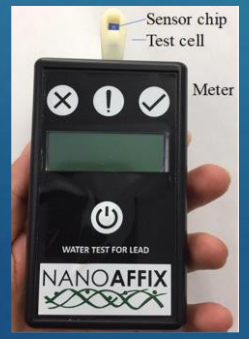




- Innovation
  - Nanoscale graphene-based sensors
  - Reduced graphene oxide (rGO)
    - Highly sensitive to surface modification
    - Measure change in conductivity when exposed to very low concentration of target contaminant.
  - Platform technology – research being conducted to detect other contaminants in water.

Prototype version 1.0

Prototype version 2.0



Beta version 3.0/ Minimum Viable Product

NanoAquaSense

- Specifications
  - Target limit of detection 1 ppb
  - Target resolution 0.1 ppb
  - Sensitivity range 1 – 30 ppb
  - Weight < 0.5 lbs
  - Bluetooth communication via smartphone app
  - Rechargeable lithium-ion battery
- Technology Readiness Level = 7
- Business Model
  - Razor/Razor Blade model
  - Meter used for years
  - Single use sensors

Competing lead testing methods

	NanoAffix tester	Paper test strips	Portable analyzers	ICP-MS in labs
Types of lead*	Total, soluble, and particulate lead	Soluble lead only (false negative)	Total lead	Total lead
Ease of use	✓	✓	X	X
Sample preparation	X	X	✓	✓
Cost	$990 ($10/sensor)	~$10-20 /kit	Typically ~$2,000 plus consumables	>$50,000 plus ~$40/test
Testing time	~1 min for soluble lead ~15 min for total lead	~10 min	~30 min for total lead	Days (sample prep. & transport)
Sensitivity	<1 ppb	>15 ppb	1 ppb	~0.02 ppb
Quantitative	✓	X	✓	✓
Onsite	✓	✓	✓	X

- Faster Analysis (onsite results in minutes with portable meter)
- Improved Accuracy (1-30ppb sensitivity with 0.1 ppb resolution)
- Less expensive (<5% of the cost of ICP-MS and about 50% less than most other portable testers)

Commercialization Progress

- Initial target market – high volume users
  - Water treatment facilities
  - Home service providers
  - Water quality professionals
- Beta-testing completed
  - Ease of sample preparation 8.8/10
  - Ease of use of app 8.6/10
  - Implemented design feedback
- Currently
  - Scaling up sensor fabrication manufacturing
  - Validate new manufacturing process before product launch

Acknowledgments

- NIEHS CRP SBIR – 1SB1ES036493-01
  - *Graphene-based Nanosensor Device for Rapid, Onsite Detection of Total Lead in Tap Water*
- NIEHS Phase II SBIR – 2R44ES028656-02A1
  - *Graphene-based Nanosensor Device for Rapid, Onsite Detection of Total Lead in Tap Water*
- EPA Phase II SBIR – 68HERC21C0048
  - *A Low-cost Handheld Sulfur Dioxide Tester with a Hybrid Nanomaterials-Based Sensor Chip*
- NIH Phase I SBIR – 1R43ES036055-01A1
  - Graphene-Based Nanosensors for Rapid Detection of Low-concentration PFAS in Water
- USDA Phase I SBIR – 2020-33610-31519
  - *A Graphene-based Handheld Device for Rapid Detection of Escherichia coli Bacteria in Water*

NIH National Institute of Environmental Health Sciences

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

USDA

NANOAFFIX
Accurate Affordable Analysis

Inventing the Future of Sensing