Detection and Spatial Mapping of Mercury Contamination in Water Samples Using a Smart-Phone

Tech ID: 24529 / UC Case 2014-515-0

SUMMARY

Researchers in UCLA Department of Electrical Engineering have developed a smart-phone based handheld platform that allows for the quantification of mercury(II) ions in water samples with parts per billion (ppb) level of sensitivity.

BACKGROUND

Long term mercury exposure in the human body by ingesting contaminated water sources could have serious neurotoxic effects on the nervous, digestive and immune systems, and on lungs, kidneys, skin and eyes. Therefore, the detection and quantification of mercury(II) ion contamination in water systems are of paramount importance, and could potentially be used to assist prevention of mercury ions from entering the food chain. Current detection of environmental contamination of trace-level toxic heavy metal ions uses spectroscopic methods such as atomic absorption spectroscopy or atomic fluorescence spectroscopy. These methods rely on complex sample preparation procedures, expensive and bulky instruments, and professionally trained personnel. However, the reality is that on-site detection of contaminants requires portable, rapid, specific, sensitive and cost-effective detection techniques that can be used in resource-limited and field settings.

INNOVATION

Researchers in UCLA Department of Electrical Engineering have developed a smart-phone based handheld platform that allows for the quantification of mercury(II) ions in water samples with parts per billion (ppb) level of sensitivity. This is on the same order of magnitude as the maximum contaminant level of mercury(II) recommended for drinking water, as established by the US Environmental Protection Agency and the World Health organization. The device integrates an opto-mechanical attachment to the built-in camera module of a smart-phone to digitally quantify mercury concentration using metal nanoparticle and colorimetric transmission assay that is implemented in disposable test tubes. This sensitive, portable, and cost-effective technology could be useful for distributed sensing, tracking and analysis of global water mercury contamination.

APPLICATIONS

On-site monitoring of heavy metal levels in water samples, specifically mercury(II).

ADVANTAGES

- Portable (opto-mechanical device weighs less than 40 grams)
- Rapid result
- High sensitivity with parts-per-billion limit of detection
- Cost-effective

STATE OF DEVELOPMENT

The researchers have built a prototype of the smart-phone based detection platform and demonstrated its functionality by measuring water samples at over 50 locations in California (USA) and generating a comprehensive mercury contamination map. The technology was able to achieve a limit of detection of ~3.5 parts per billion.

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INVENTORS

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OTHER INFORMATION

KEYWORDS

Smart-phone sensor; mercury detection; colorimetric sensor; gold nanoparticles; aptamers; hazard monitoring; chemical hazard; decontamination

CATEGORIZED AS

- **Environment**
  - Sensing
- **Sensors & Instrumentation**
  - Environmental Sensors
- **Engineering**
  - Other

RELATED CASES

2014-515-0

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	10,365,214	07/30/2019	2014-515

RELATED MATERIALS

- Wei, Q. S.; Nagi, R.; Sadeghi, K.; Feng, S.; Yan, E.; Ki, S. J.; Caire, R.; Tseng, D.; Ozcan, A. Detection and Spatial Mapping of Mercury Contamination in Water Samples Using a Smart-Phone, ACS Nano 2014, 8, 1121 - 1129

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Automated Semen Analysis Using Holographic Imaging
- Low-Cost And Portable Uv Holographic Microscope For High-Contrast Protein Crystal Imaging
- Extended Depth-Of-Field In Holographic Image Reconstruction Using Deep Learning-Based Auto-Focusing And Phase-Recovery
- Computational Cytometer Based On Magnetically-Modulated Coherent Imaging And Deep Learning
- Lensfree Tomographic Imaging
- Single Molecule Imaging and Sizing of DNA on a Cell Phone
- Cross-Modality Deep Learning Brings Bright-Field Microscopy Contrast To Holography
- Microscopic Color Imaging And Calibration
- Quantification Of Plant Chlorophyll Content Using Google Glass
- Rapid, Portable And Cost-Effective Yeast Cell Viability And Concentration Analysis Using Lensfree On-Chip Microscopy And Machine Learning
- Holographic Opto-Fluidic Microscopy
- Design Of Task-Specific Optical Systems Using Broadband Diffractive Neural Networks
- Ultra-Large Field-of-View Fluorescent Imaging Using a Flatbed Scanner
- Revolutionizing Micro-Array Technologies: A Microscopy Method and System Incorporating Nanofeatures
- Tunable Vapor-Condensed Nano-Lenses

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