Docket #: S20-002

Ultratrace and Multiplex Visual/Smartphone Detection of Heavy Metal Ions by their Sulfidation on a Superhydrophobic Concentrator

Stanford researchers have developed a portable sensor device for rapid detection of heavy metal ions using a sulfidation process and concentrator for increased visual detection. The device achieves ultratrace and multiplex quantification of Pb^{2+}, Ni^{2+}, Cr^{3+}, Cu^{2+} and Co^{2+} in 8 minutes with 90% accuracy and only requires 5 microliters of sample. The device contains four components: 1) a superhydrophobic concentrator (SPOT) sensor, 2) a miniature droplet heater, 2) a portable microscope, and 4) a smartphone image analyzer. In contrast to conventional optical sensors, this device's mobility allows for on-site testing of wastewater, groundwater, and soil etc. The unique SPOT concentrator continuously accumulates the heavy metal sulfides making visual detection easy down to a lower detection limit of 0.1 nanomolar, 3-6 orders of magnitude higher than WHO and EPA permissible levels. This device is applicable for field testing and other environmental monitoring purposes.

Stage of Research

- Prototype

Applications

- On-site detection of heavy metal ions in water or soil
- Concurrent quantification of multiple heavy metal ion species
- Quick comprehensive analysis: 8 minutes and 90% accuracy

Advantages

- Quantifies concentrations from 0.1 nanomolar to 1 millimolar for Pb^{2+}, Ni^{2+}, Cr^{3+}, Cu^{2+} and Co^{2+}
- Concentrates analytes to improve visual detection sensitivity
- Only requires 5 microliter samples
- Low cost sulfidation reagent reduces overall cost vs conventional optical sensors
- Reusable: concentrator only requires acidic wash to clean

Publications

- Cui et al. Sensitive, portable heavy-metal-ion detection by the sulfidation method on a superhydrophobic concentrator (SPOT) *One Earth,*. MAY 21, 2021.

Patents

- Published Application: 20210364489

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