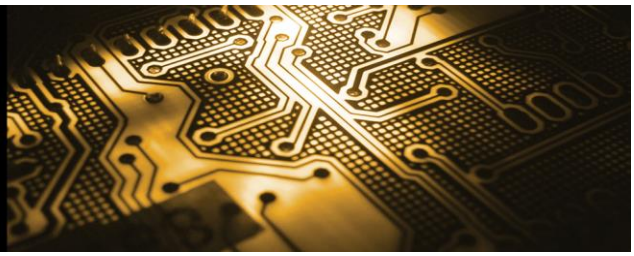
UWM RESEARCH FOUNDATION **Technology Overview**

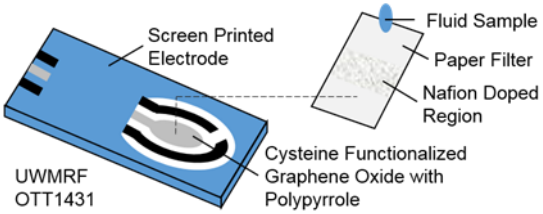


Highly Sensitive Detection of Heavy Metals

OTT ID #1431

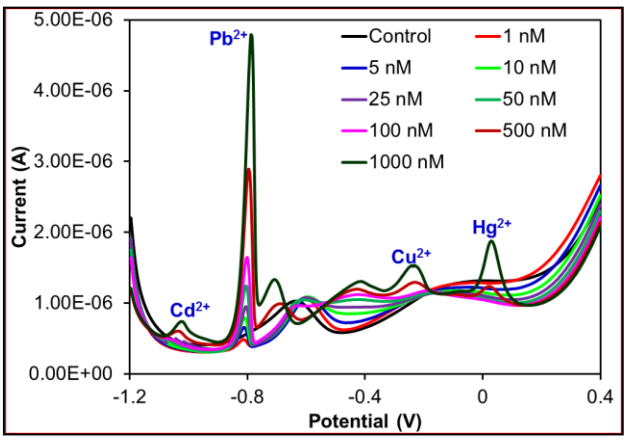
TECHNOLOGY

Dr. Woo-Jin Chang and Dr. Sundaram Gunasekaran have created a heavy metal ion and pH sensing device. This sensor utilizes a new electrode material of cysteine functionalized graphene oxide (sGO) with polypyrrole (PPy) that enables greater level of detection (0.07 ppb for Pb^{2+}) for heavy metal ions. The device includes the deposition of nafion on the paper test strip, aiding in pre-concentration of the fluid sample as it wicks through the paper for increased sensing performance. The electrode determines the pH independent from heavy metals, and the measured pH can be used to correct pH-heavy metal concentration-sensor measurement curves for determining accurate heavy metal concentrations regardless of the pH of the sample.

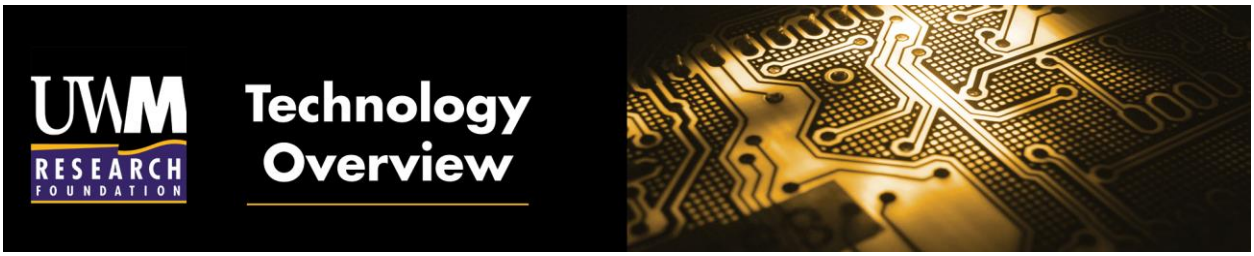


Compared to other current methods, the sGO/PPy nanocomposite has high stability and ultrahigh sensitivity to detect lead at levels two orders of magnitude below the 10 ppb limit for drinking water set by the WHO. This device is low cost, portable, easy to use, sensitive, and utilizes disposable sensor components. Current analytical devices used to determine the heavy metal concentrations are expensive, bulky, require professional operators, and higher operation cost. Few options for portable equipment are available, however, those available have limitations in cost, portability, and detection limit. Our sensor can be used for disposable one time use, as well as long-term monitoring.

FEATURES/BENEFITS



- **Long Term Stability** – the materials of the nanocomposite are stable for multiple sample use for extended periods of time
- **Ultrahigh Sensitivity** – the sGO/PPy nanocomposite film can detect lead below the 10 ppb limit for drinking water set by the WHO
- **Inexpensive –** the materials are easy to source and fabricate
- **User Friendly –** the device can be set up quickly and is calibration-free
- **Reliable –** the results are highly reproducible
- **Specific –** multiple heavy metals can be analyzed in single run, and curves for the various heavy metals can be easily distinguished
- **Low sample volume –** very little liquid (10 µL or less) is needed to detect the heavy metal and pH content



INTELLECTUAL PROPERTY

WO 2016/090176

This technology is available for non-exclusive licensing and is available for further research support in detection of additional metals.

MARKETS

Contamination of soil, groundwater, and air with heavy metals such as lead (Pb), mercury (Hg), cadmium (Cd), copper (Cu), zinc (Zn), etc. is a major environmental problem. Even in trace concentrations, heavy metals present in air, food, and drinking water can bio-accumulate and thus pose major threat to human health. Lead is widely recognized as highly toxic and non-biodegradable; it is a potent neurotoxin and a carcinogen, and causes lung disease, stroke, kidney problems, high blood pressure, etc. The World Health Organization (WHO) has established a guideline limiting Pb concentration in drinking water to 10 ppb. According to the United States Environmental Protection Agency (USEPA), 10 to 20% of adults and 40 to 60% of infants are exposed to Pb via drinking water.

The global market for Water Analysis Instrumentation is projected to reach US$3.6 billion by 2020, driven by the ubiquity of water testing for residential, commercial, and industrial uses**.** The global market for chemical sensors is projected to reach $26.4 billion by 2018. The supply of clean and safe water has been a major challenge confronted by both municipal organizations and industries. Rapid growth in population and industrialization has led to significant contamination of water resources thus aggravating water shortage issues. Water analysis is critical in residential, commercial, and industrial sectors. Demand for water analysis instruments is supported by the growing levels of water contamination and the resulting legislation of stringent water quality control regulations.

INVENTORS

Sundaram Gunasekaran, Woo-Jin Chang, Jiang Yang, Rajesh Seenivasan

Dr. Gunasekaran is currently a Professor in the Biological Systems Engineering department at the University of Wisconsin-Madison. He holds a Ph.D. in Agricultural Engineering from the University of Illinois, Urbana. Dr. Gunasekaran's primary interests are in areas of engineering properties of food and biomaterials with special emphasis on rheological properties. He also has interests in sensors and instrumentation, specifically in the area of the nondestructive evaluation of properties and quality of food materials and development of biosensors for measuring certain allergens and toxins. Dr. Chang is currently an Assistant Professor of Mechanical Engineering at the University of Wisconsin-Milwaukee. He holds a Ph.D. in Biological Engineering from Inha University (Republic of Korea). Dr. Chang has multiple research interests including biosensors, BioMEMS and microfluidic device development, field effect transistor (FET) biosensors, microfluidic aqueous two-phase extraction systems and microfluidic cell culture and monitoring.

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