

A Disposable Sensor for the On-Site Detection of Lead and Cadmium

Connor Sullivan, Guinevere Strack, Michaela Fitzgerald, and Pradeep Kurup

As illustrated by the recent catastrophe in Flint, Michigan—in which up to 12,000 children were found to have toxic levels of lead in their blood—heavy metals present a major risk to human health and the environment. Current detection methods of heavy metal testing require expensive laboratory-based equipment, highly trained personnel, and hazardous chemicals, resulting in high costs and long wait times. To facilitate more frequent and less expensive testing, our research group has developed an environmentally friendly voltammetric sensor strip for the onsite detection of heavy metals in groundwater and drinking water. The sensor strip consists of a novel, bismuth-based working electrode, a carbon counter electrode, and a silver/silver chloride reference electrode. An innovative bismuth layer provides enhanced deposition of lead and cadmium onto the surface of the electrode, thus resulting in the low detection limits that are required for drinking water standards. When combined with a nontoxic reagent—to control pH and minimize sample interferences—the bismuth working electrode enabled square wave stripping voltammetry experiments that detect low parts per billion levels of lead and cadmium in five minutes or fewer. Laboratory tests were performed in a range of water matrices. The sensor was shown to provide accurate measurements for lead and cadmium over a concentration range of 0 to 100 ppb. Additionally, through a partnership with the Massachusetts Department of Environmental Protection, the researcher gathered and tested a number of water samples from contaminated sites, to demonstrate the potential of the sensor for real world applications.

Connor Sullivan, University of Massachusetts Lowell, 1 University Avenue, Lowell, MA, United States, 01854, Tel: 978-835-9517, connor_sullivan1@student.uml.edu

Guinevere Strack, University of Massachusetts Lowell, 1 University Avenue, Lowell, MA, United States, 01854, guinevere_strack@uml.edu

Michaela Fitzgerald, University of Massachusetts Lowell, 1 University Avenue, Lowell, MA, United States, 01854, Michaela_Fitzgerald@student.uml.edu

Pradeep Kurup, University of Massachusetts Lowell, 1 University Avenue, Lowell, MA, United States, 01854, pradeep_kurup@uml.edu

Presenting Author: Connor Sullivan