A Microfabricated Electrochemical Sensor for Continuous, On-site Analysis of Arsenic in Water

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Abstract

Arsenic pollution of groundwater across the world is one of many issues that have highlighted the need for a reliable instrument capable of monitoring contaminants remotely and continuously in a variety of geographical locations. Typical instrumentation for water analysis, such as ICP and AAS, must be housed in a central lab and provides only a very limited snapshot of the water quality representative of the particular time and location associated with sample collection. Portable instruments require a skilled technician who must travel to the field to operate the equipment and still provide only a snapshot analysis. Our group is focused on developing a truly remote electrochemical sensor positioned in the field that permits continuous, operator-free, in situ analysis. The sensor is based on exhaustive anodic stripping coulometry in a fixed-volume cell, and the target analyte is arsenic (III) at trace levels in water. This work has been successful in monitoring arsenic below the WHO maximum contaminant level of 10 ppb via two microfabrication methods. First, the sample volume was varied from 4 µL to 16 µL by a "stamp-and-stick" fabrication procedure to increase analyte signal. Second, the 8 mm by 4 mm elliptical working electrode was replaced with a microelectrode array in which active electrode sites varied in diameter from 5 µm to 50 µm to decrease noise. Furthermore, the electrochemical cell is being interfaced with a platform for deployment as a remote, autonomous instrument. The platform would allow for automated sample intake, sample pretreatment (e.g., filtration and acidification), electrochemical analysis, and wireless data communication in a few minutes. By integrating the fixed-volume sensor with the platform for remote operation, it is feasible to construct a remote sensing device that is affordable (~ $600) and is well suited for creation of permanent sensor networks.

Biography of Presenter

Kelsey Kaht, a native of Florence, KY, graduated with a BA in Biology and a BA in Chemistry from Thomas More College in 2014. She then joined the lab of Richard Baldwin at the University of Louisville where she earned her MS in Chemistry in 2017 and is currently working toward completing her PhD in Chemistry. Her research focuses on using electrochemistry to remotely monitor trace metals in water. Outside of the lab, Kelsey serves as the President of the Graduate Student Council at the University of Louisville, is a Graduate Student Ambassador, and enjoys baking and doing jigsaw puzzles.