WINSSS

Water Innovation Network for Sustainable Small Systems

A National Center for Innovative Small Drinking Water Systems

B3: ***A Distributed Sensing and Monitoring System: applications to SWTR compliance and point of use devices -*** Development of new, inexpensive disposable sensor with specific utility for small systems.

Rebecca Lai, University of Nebraska

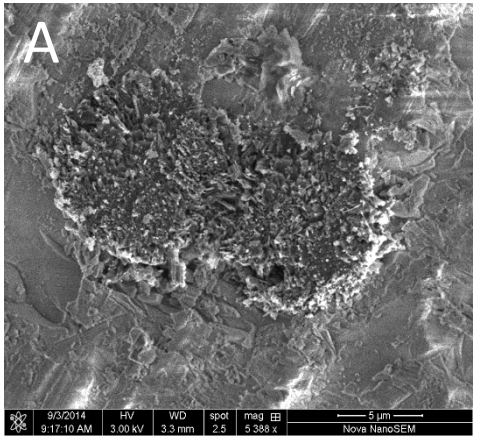
University of Nebraska Lincoln

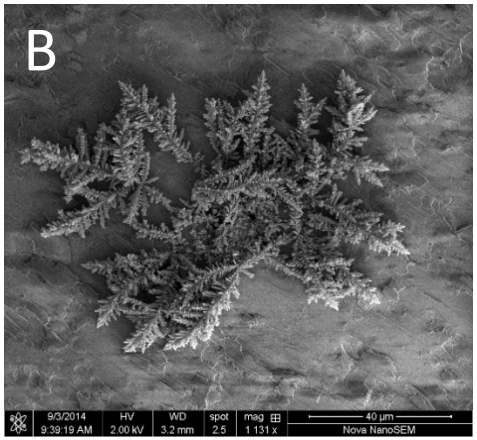
Introduction

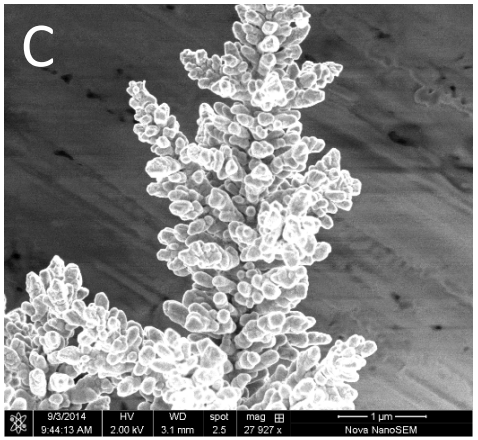
- *Brief Description:* Develop inexpensive disposable sensors with specific utility for small systems.
  - ➢ Potential cost in range of $0.5 - $1 /sensor
  - ➢ Fast, accurate, sensitive, and specific
- *Anticipated target utility characteristics:*
  - ➢ All utilities could potentially benefit. Especially those that may consider monitoring specific points-of-entry devices.
- *Continuum of technology development:*

Nanostructured Silver-modified Electrodes for Detection of Nitrate

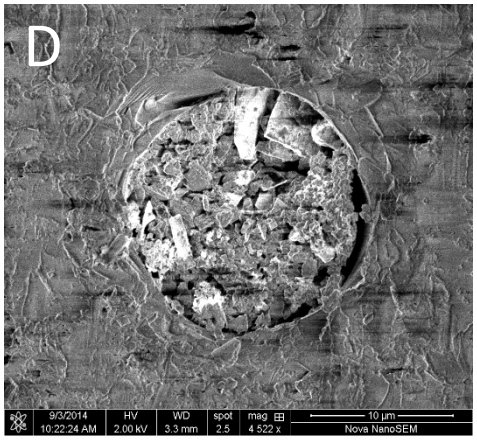
Carbon Fiber Microelectrode (10-µm diameter)

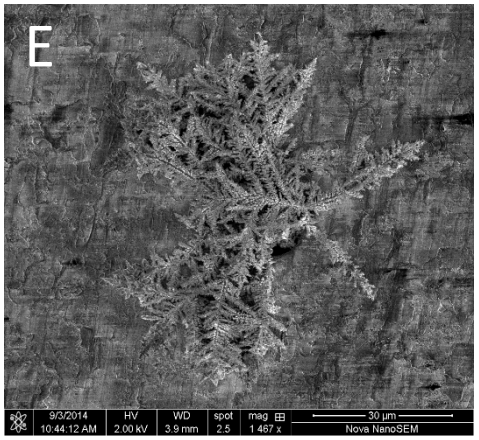


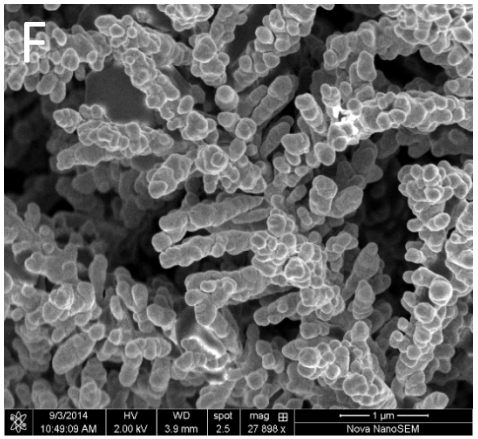




Silver Wire Microelectrode (15-µm diameter)

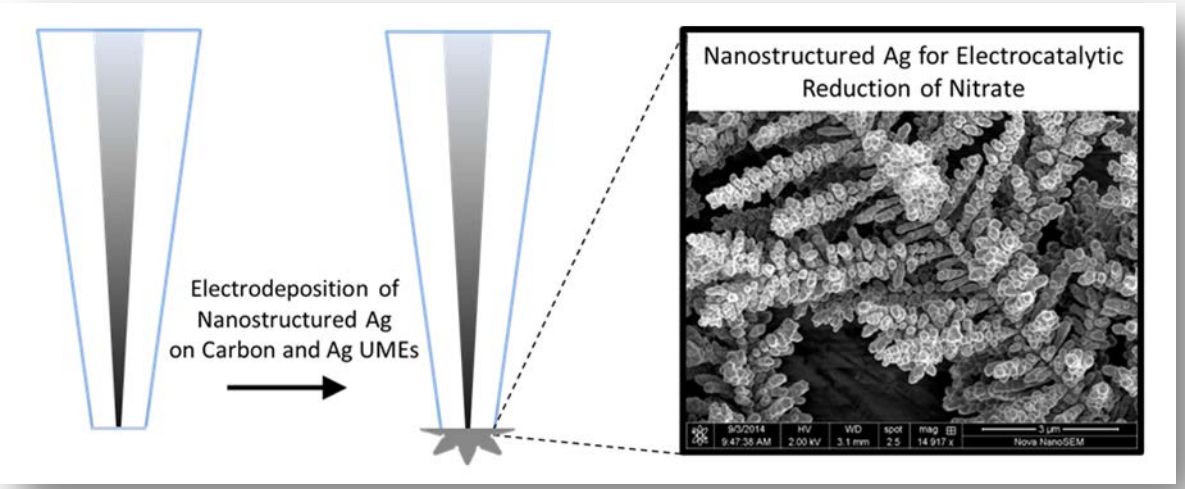


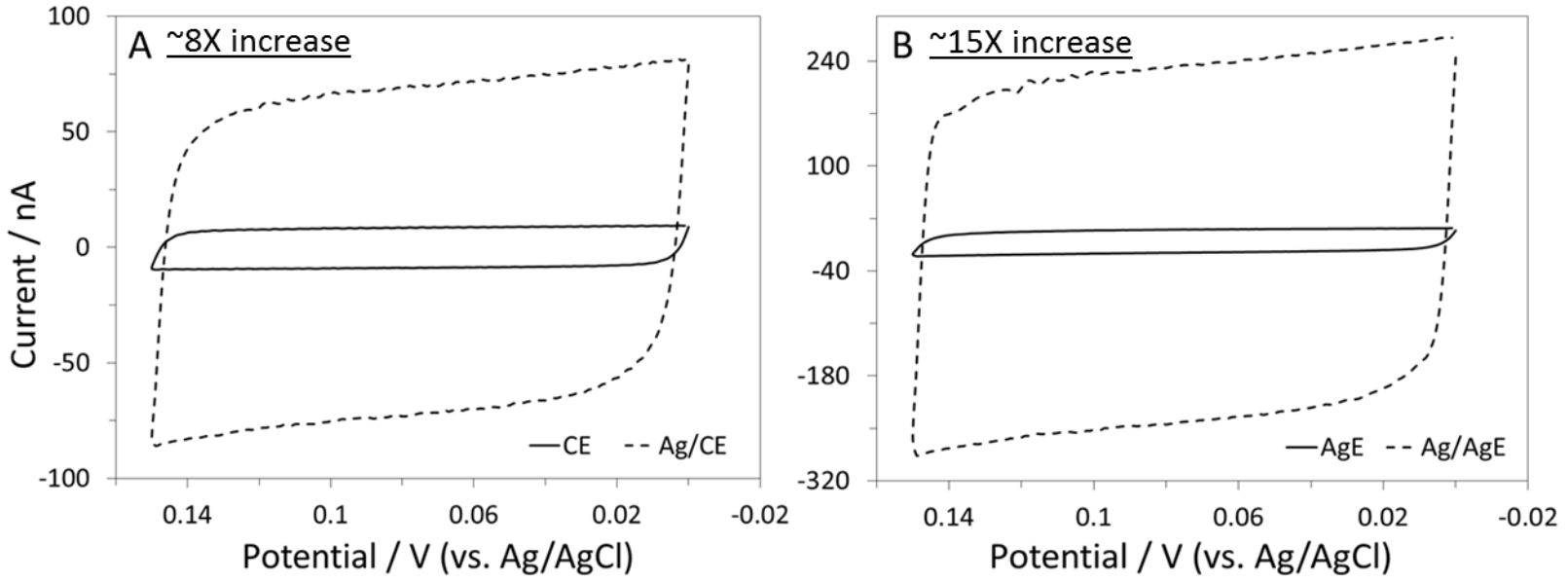




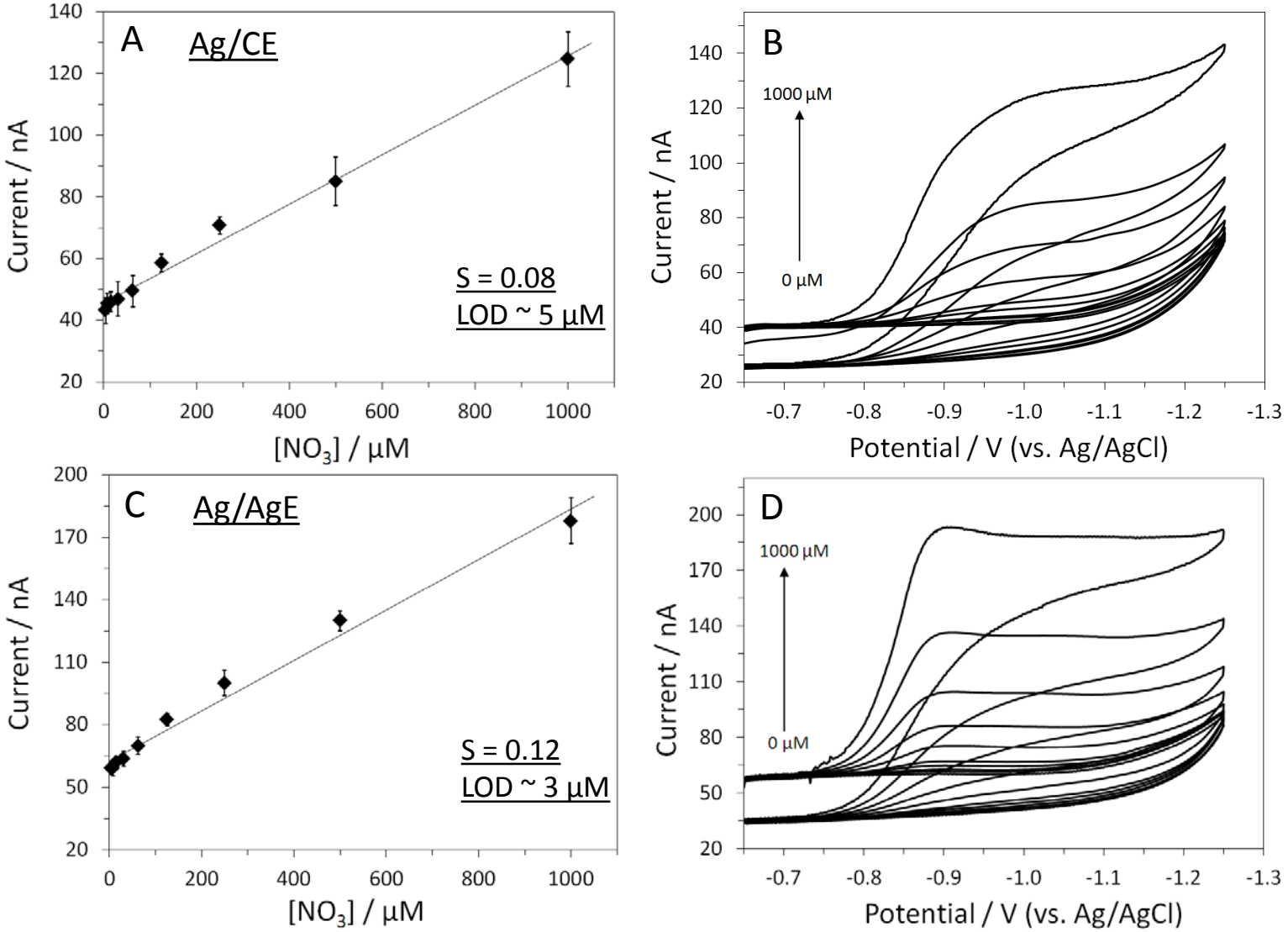
Lofti Z Z, H. R.; Lai, R. Y., Anal. Chim. Acta, 2015, 892, 153-159.

Electrode Characterization: Increase in Surface Area





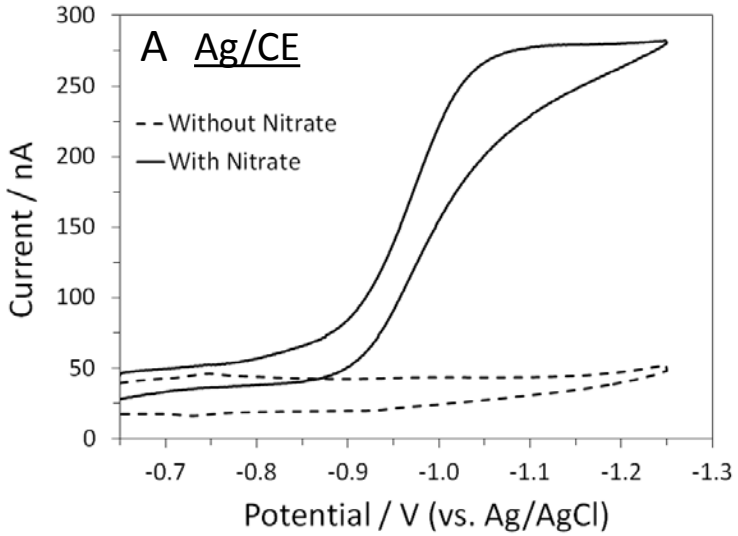
Sensor Response: Dose-response Curves in CV

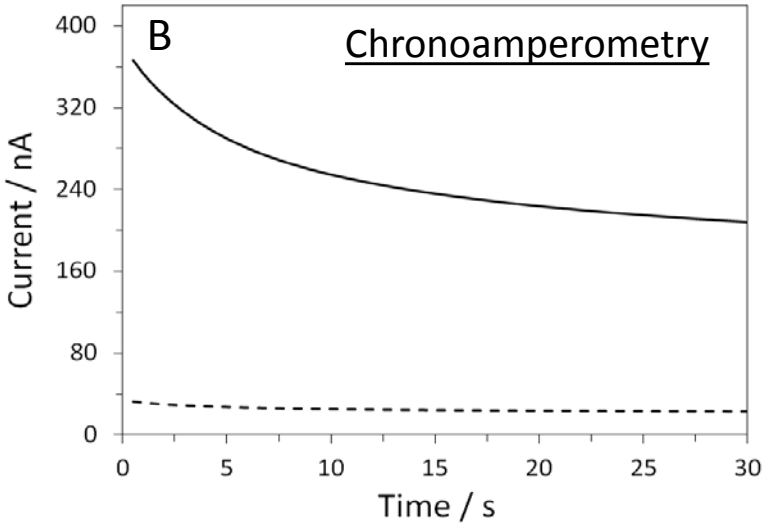


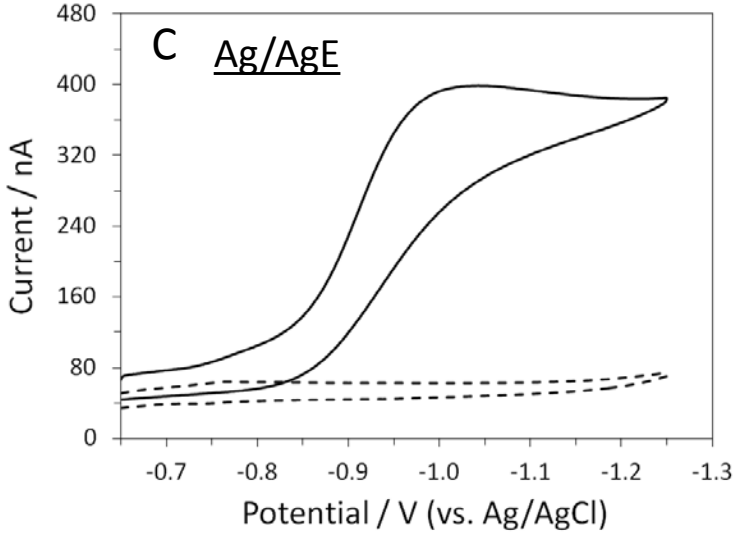
10 ppm nitrate as N equals 45 ppm nitrate as NO_3^- (~726 µM NO_3^-)

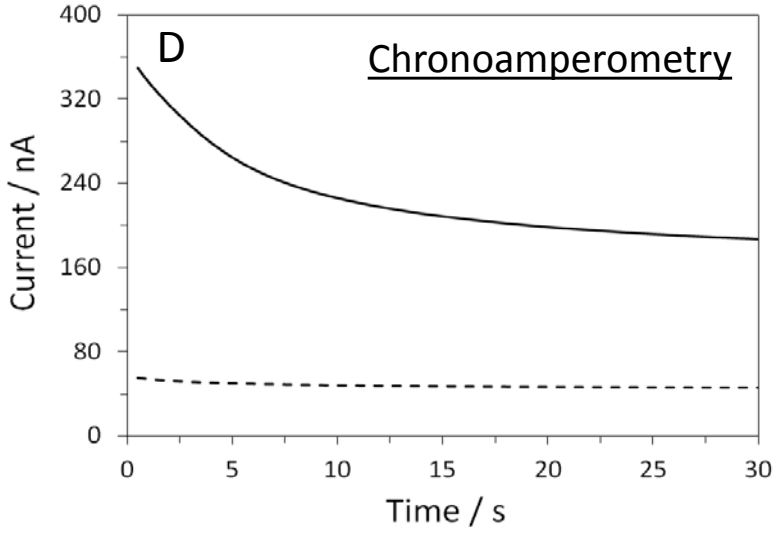
Method 10-107-04-1-A (0.2 – 20 ppm N) = 14.52 – 1452 µM NO_3^-

Sensor Response in Synthetic Aquifer Sample



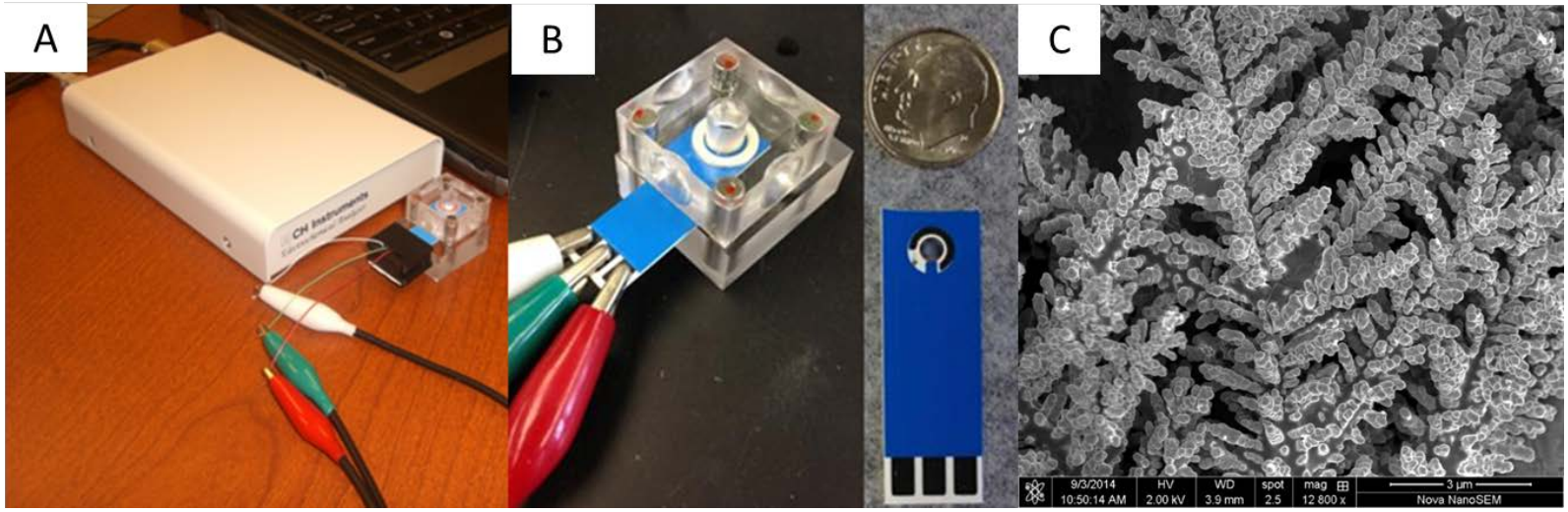


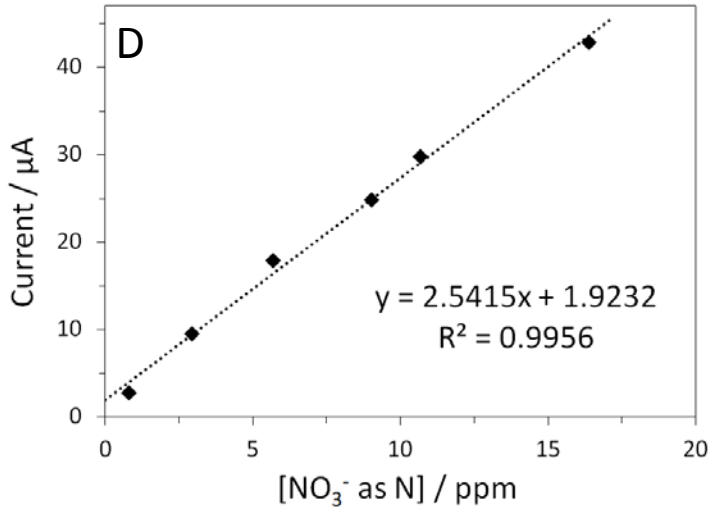


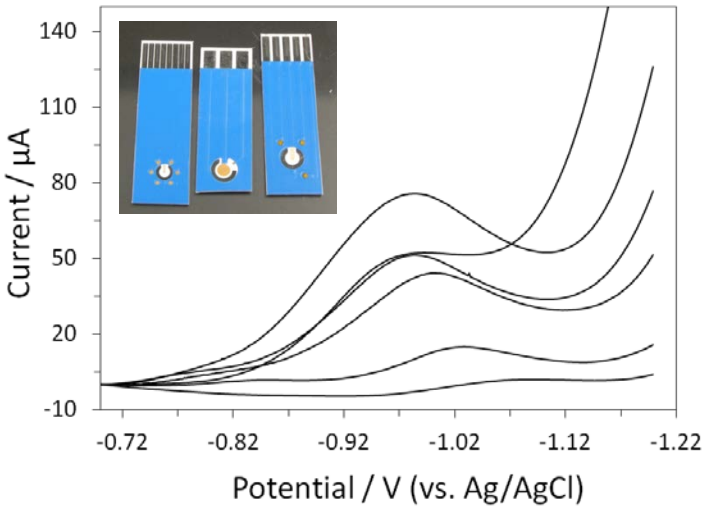


South Dakota Minnelusa Aquifer Surface Water
(Water-Resources Investigations Report 01–4194 U.S. Department of the Interior, Denver (2001))
127 mg/L Ca(II), 32 mg/L Mg(II), 521 mg/L Na(I), 3 mg/L K(I), 252 mg/L bicarbonate, 257 mg/L sulfate, 12 mg/L chloride, 0.5 mg/L fluoride, 0.3 mg/L bromide, and 0.01 mg/L iodide

Sensor Fabricated on Disposable Paper Electrodes







H_2SO_4 acidified samples from Nebraska Public Health Environmental Lab
Lachat 8500 (Method 10-107-04-1-A) (EPA 353.2) (0.2 – 20 ppm N as NO_3^-)

Outputs and Outreach

Completed:

- "State Survey on Acceptance of New Technology", EPA Small Systems Workshop, Cincinnati, August, 2015.
- "Developing a Better Understanding of Drinking Water Technology Approval", ASDWA Annual Conference, October, 2015.
- "State Survey to Improve Our Understanding of DW Treatment Technology Approval", National Centers for Innovation in Small Drinking Water Systems (DeRisk, WINSSS, RE'SEAU), Dec., 2015.
- Electrochemistry Conference, University of Texas at Austin, Austin, TX (Feb 2015)
- University of California at Riverside, Department of Chemistry, Riverside, CA (Jun 2015)
- Michigan State University, Department of Chemistry, East Lansing, MI (Apr 2015)
- University of Nebraska-Omaha, Department of Chemistry, Omaha, NE (Sep 2015)

Scheduled:

- "Finding common ground for standardized approaches for state regulatory approval of new technologies ", AWWA ACE, Chicago, June 2016.
- Data Sharing with WINSSS State Regulation Workgroup, Feb. 2016
- Truman State University, Department of Chemistry, Kirksville, MO (Apr 2016)

Publications

- Comparison of Nanostructured Silver-modified Silver and Carbon Ultramicroelectrodes for Electrochemical Detection of Nitrate. Lofti Z Z, H. R.; Lai, R. Y., Anal. Chim. Acta, 2015, 892, 153-159.

Anticipated:

- Short description for WINSSS website, Fall 2016.
- Manuscript for submission to a technical Journal (Electrochemical Peptide-based Lead Sensor – 2016; Conductivity Sensor – 2017)
- Possible WINSSS Webinar – 2017