NAME: Andres Campiglia
ORGANIZATION: Department of Chemistry, University of Central Florida
PROGRAM AFFILIATION: SBR
ABSTRACT TITLE: Field-Deployable Nanosensing Approach for Real-time Detection of Free Mercury

ABSTRACT: Our proposition targets a critical element of the Environmental Remediation Science Program (ERSP) research portfolio, which is the development of enabling scientific tools for characterizing the spatial and temporal evolution of complex subsurface systems. We propose a field-portable, on-site sensing device for real-time speciation of elemental and inorganic mercury in surface stream waters, groundwater, and sediment samples. During the past year of the project, our efforts were directed towards: (a) the development of an optically transparent nanorod-modfied electrode for measurement of mercury using surface plasmon resonance (SPR) with electrochemical reduction of Hg species; and (b) the design and set-up of a portable spectrometer (prototype) for field measurements of mercury. A systematic approach was developed for the immobilization of gold nanorods (Au NR) on Indium Tin Oxide (ITO)-coated glass cover slides via covalent binding through (3-mercaptopropyl)trimethoxysilane (MPTMS). Experimental parameters were optimized for appropriate MPTMS surface coverage, CTAB removal, and ionic strength conditions that provide reproducible immobilization of commercially-available Au NRs on ITO surfaces. An application of potential controlled SPR sensing is demonstrated with Hg-Au amalgam formation at the NR surface, where $HgCl_2$ is reduced with applied potential at the Au NR surface, resulting in a characteristic change in SPR spectrum. The original version of the portable spectrometer was significantly improved with the implementation of numerous modifications. These included newly designed sensor head (or sensor box) and input box for fiber optic bundles. Instrument control is now possible with the aid of a laptop. An in-house LabView data acquisition program facilitates computer control of the water flow, real-time spectral acquisition, correlation of maximum wavelength shifts to mercury concentration and instrument calibration.