Project ID: **65001**

Project Title: **Development of Novel, Simple, Multianalyte Sensors for Remote Environmental Analysis**

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Research Objective

We will develop simple, inexpensive new chemical sensing materials which can be used as visual color test strips to sensitively and selectively report on the concentration and identity of environmental pollutants such as cations of Pb, U, Pu, Sr, Hg, Cs, Co as well as other species. We will develop inexpensive chemical test strips which can be immersed in water to determine these analytes in the field. We will also develop arrays of these chemical sensing materials which will be attached to fiber optic bundles to be used as rugged multichannel optrodes to simultaneously monitor numerous analytes remotely in hostile environments.

These sensing materials are based on the intelligent polymerized crystalline colloidal array (PCCA) technology we recently developed. This sensing motif utilizes a mesoscopically periodic array of colloidal particles polymerized into an acrylamide hydrogel. This array Bragg diffracts light in the visible spectral region due to the periodic array of colloidal particles. This material also contains chelating agents for the analytes of interest. When an analyte binds, its charge is immobilized within the acrylamide hydrogel. The resulting Donnan potential causes an osmotic pressure which swells the array proportional to the concentration of analyte bound. The diffracted wavelength shifts and the color changes. The change in the wavelength diffracted reports on the identity and concentration of the target analyte.

Our successful development of these simple, inexpensive highly sensitive chemical sensing optrodes, which are easily coupled to simple optical instrumentation, could revolutionize environmental monitoring. In addition, we will develop highly rugged versions, which can be attached to core penetrometers and which can be used to determine analytes in buried core samples.

Research Progress and Implications

This report summarizes work after nine months of a three year project. We have developed a new method to crosslink our PCCA sensing materials with disulfide bridges. We cleave these bridges which then yeild thiols which complex with heavy metals. We have demonstrated sensing of As(III). We are now investigating the utility of this sensing material for other heavy metals and are attempting to template the recognition sites for heavy metals.

Planned Activities

We are continuing on our plan to develop simple, inexpensive new chemical sensing materials which can be used as visual color test strips to sensitively and selectively report on the concentration and identity of environmental pollutants such as cations of Pb, U, Pu, Sr, Hg, Cs, Co as well as other species. We will develop inexpensive chemical test strips which can be immersed in water to determine these analytes in the field. We will also develop arrays of these chemical sensing materials

which will be attached to fiber optic bundles to be used as rugged multichannel optrodes to simultaneously monitor numerous analytes remotely in hostile environments.

Information Access

The following references give further information on our chemical sensing materials.

"Intelligent Polymerized Crystalline Colloidal Array Hydrogel Film Chemical Sensing Materials", J. H. Holtz and S. A. Asher, Nature 389, 829-832 (1997).

"Intelligent Polymerized Crystalline Colloidal Arrays: Novel Chemical Sensor Materials," J. H. Holtz, J. S. W. Holtz, C. H. Munro, and S. A. Asher, Anal. Chem. 70, 780-791 (1998).

"Mesoscopically Periodic Photonic Crystal Materials for Linear and Nonlinear Optics and Chemical Sensing", J. Holtz, J. Weissman, G. Pan and S. A. Asher, Material Research Soc. 23, 44-50, (1998).