In-line Uranium Immunosensor

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The goal of this project is to develop an in-line uranium immunosensor that can be used to determine the efficacy of specific biostimulation approaches. The DOE–NABIR program is presently funding a project to develop and test a handheld immunosensor that will provide a rapid, portable assay for hexavalent uranium. For in situ stabilization processes (i.e., the "push-pull" experiments or nutrient "recycling" trials), however, an in-line sensor that could monitor the removal of uranium (or other radionuclides) over longer periods of time would have distinct advantages. It would operate autonomously and provide near real-time data about uranium immobilization in the absence of personnel at the site. In fact, the idea for this sensor was generated after discussions with investigators performing in situ stabilization experiments at the NABIR Field Research Center at Oak Ridge National Laboratory. This site is proposed for the testing and initial deployment of the sensor. The project is a joint effort between the Blake laboratory at Tulane and Sapidyne Instruments, Inc, and has three technical goals:

1. Construction of an in-line immunosensor for hexavalent uranium after engineering discussions with the final users;
2. Incorporation of the reagents already developed for the handheld immunosensor into this device and testing of its performance capabilities with hexavalent uranium spiked into buffer and groundwater samples;
3. Determination of the capabilities of the in-line sensor during upcoming field tests at the FRC.

A prototype device (a modification of a KinExA 3000 instrument already available in the PI's laboratory) has been installed. A commercially available antibody-antigen-capture reagent system with binding properties similar to the uranium system was identified. This system (antibiotin-biotin-biotin-BSA) was used to test the ability of the prototype sensor to (1) provide a linear dose response with antibody concentration; (2) respond appropriately to increasing quantities of antigen; and (3) autonomously dilute reagents from stock solutions. After minor design changes, the first prototype passed all three performance tests. Work is underway to finalize the design of the optics modules, which will determine the space and power requirements of the final unit.