

PROJECT FACT SHEET

Rapid Deployment of Engineered Solutions for Environmental Problems at Hanford - FIU's Support for Uranium Remediation at the Hanford Site

FIU's Applied Research Center (ARC) and Nanobioengineering Laboratory, Biomedical Engineering Department (BME), are supporting the U.S. Department of Energy's Hanford Site in developing a strategy to improve the efficiency of uranium stabilization process through polyphosphate injection technology.

Injections of a soluble sodium tripolyphosphate amendment into the uranium contaminated groundwater and soil have been shown to effectively sequester uranium through the formation of insoluble uranyl phosphate minerals. Polyphosphate undergoes hydrolysis in aqueous solutions to orthophosphate forms, which serve as readily available nutrients for the various micro-organisms that thrive under the specific conditions and may even lead to an increase in their growth. An increase in the microbial activity was observed in the site followed by the polyphosphate injection in the groundwater. The presence of rapidly adapting bacterial populations in sediment could strongly influence the migration/dissolution of uranium. Therefore, understanding the role of bacteria in phosphate remediation technology and the interactions between meta-autunite and the microbes are very important. Of particular concern is the long-term stability of the sequestered uranium in the subsurface that may undergo subsequent remobilization.

Objectives

- Examine the ability of oligotrophic microbial species to influence the dissolution pathways of uranium (VI) present in the groundwater as a stable meta-autunite.
- Evaluate the role of bacteria in phosphate remediation technology in downward movement of U(VI) and other elements induced by bacterial inoculation in order to prevent secondary pollution to groundwater.
- Develop a highly selective and specific uranyl biosensor with the aid of superparamagnetic core-shell nanoparticles immobilized with an organophosphorous compound for uranium detection and binding.
- Conduct dissolution experiments in batch reactors and exploit a miniaturized sensor to systemically monitor multi state variables of uranium dissolution such as uranium concentration and bacterial cell numbers.

- Study the influence of temperature and pH on uranium dissolution in the presence of microbes and quantify dissolution rates of the uranyl phosphate species using highly specific nano-biosensors.

Benefits

- Evaluate the role of bacteria in the uranium dissolution from autunite mineral.
- Provide dissolution rates of autunite minerals under appropriately simulated conditions and evaluate their impact on the fate and transport of uranium in groundwater.
- Develop a computational model for uranium dissolution and transport in the groundwater.

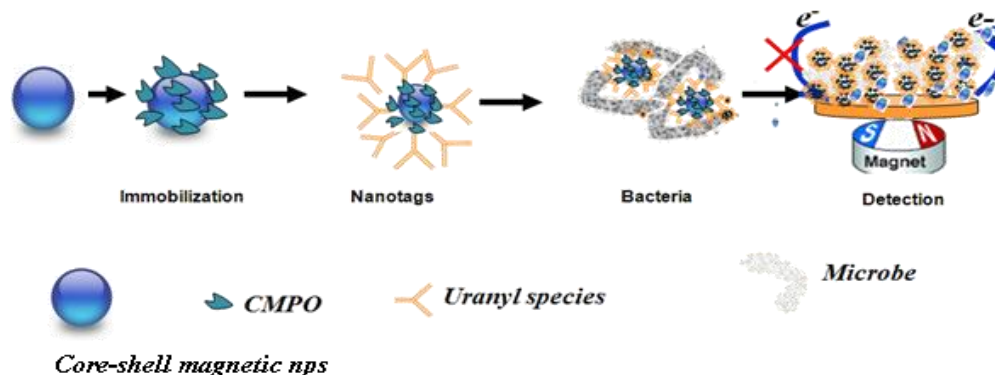


Figure 1. Nano-biosensor system