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Synchrotron Radiation Studies of Environmental Materials

DANIEL OLIVE, JEFF TERRY, Illinois Institute of Technology — In the case of environmental contaminants, the mobility of elements changes depending on oxidation state. Remediation techniques often focus on changing the oxidation state in order to immobilize, by forming an insoluble species, or removing by binding a soluble species to an insoluble material. In order to accomplish this immobilization one has to understand all the possible reactions that can change the oxidation state. One of the techniques that can be used to determine the oxidation state and local atomic structure of environmental contaminants under aqueous conditions is x-ray absorption spectroscopy (XAS). Synchrotron radiation was used to excite the absorption edges of As, Tc, and Pu, in order to characterize their oxidation states and structures under environmentally relevant conditions. Granular activated carbon treated with iron has shown promise for the removal of arsenic from contaminated ground water, where XAS measurements have determined that the arsenic bound to iron oxide as AsO_4^{3-}. Pertechnetate (TcO_4^-) was found to be reduced to TcO_2 in a reaction with amorphous iron sulfide (FeS). Bio-reduction of plutonium has also been studied using bacteria that may be found in nuclear waste repositories resulting in an end product of Pu(III).

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