Photochemistry of Ferrihydrite in the Protein Cage of Ferritin for Chromate Reduction

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Ferrihydrite (Fh) is a ubiquitous iron oxyhydroxide phase in the environment. It is a small band gap semiconductor and can facilitate photochemistry in the environment (typically light wavelengths, $\lambda, < 475$ nm). The Fh phase also is the inorganic core of the iron sequestration protein, ferritin (Ftn). In this presentation research will show how this biomaterial composed of a geochemically important phase can be used to drive interesting environmental chemistry. In particular, the light driven photochemistry of Fh mineralized within Ftn toward the reduction of the high priority pollutant, chromate as CrO_4^{2-} (Cr(VI)) will be discussed. It is also shown that the growth of small metal particles (e.g., Au) on the exterior of ferritin with a plamonic resonance in the visible can be used to extend the photochemistry of the ferrihydrite further into the visible part of the solar spectrum (i.e., $\lambda > 475$ nm). Experimental results demonstrate that the Au nanoparticles need to be intimately bound to Ftn (although not bound directly to the Fh) to affect the light wavelength dependent photochemistry of ferrihydrite. Results from spectroscopic and microscopy techniques will be presented that help understand the mechanism by which the plasmonic particles extend the photochemistry of the ferrihydrite phase within Ftn to longer wavelength relative to Au-free Ftn.