XANES Characterisation of Cu(II) Remediation Using Novel Metal-Phosphate Nanoparticles

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Copper [Cu(II)] is a toxic heavy metal regulated by US EPA. Urban soils and waters due to anthropogenic activities can result in Cu(II) concentrations exceeding the regulatory levels. Engineered nanoparticles have been very effective in *insitu* remediation. The metal-phosphate nanoparticles are effective in complexing transition metals and their phosphate precipitates are stable over a wide pH range. They therefore offer great potential for Cu(II) remediation. The main objective of this study was to evaluate molecular mechanisms of Cu(II) immobilization on novel Fe-PO_4 (~10 nm) and Ca-PO_4 nanoparticles (~200 nm) in the presence of citrate and desferrioxamine-B (DFO-B) over a period of 14 days. Spectroscopic [Cu L-XANES] and imaging [TEM-EDS] approaches were used for speciating Cu(II). Copper (II) standards for adsorbed Cu [$CuNO_3$] and surface precipitated Cu [$CuPO_4$] were used to represent different molecular mechanisms of immobilization. Cu L-edge XANES spectra showed Cu(II) speciation over time (Fig.1). Ca-PO_4 nanoparticles immobilized Cu(II) as a surface precipitate at day 1 and day 14; Similarly, Fe-PO_4 nanoparticles adsorbed Cu(II) at day 1 and transformed it to a surface precipitate by day 14 (Fig.1). The results show metal-phosphate nanoparticles remediation efficacy in the presence of ligands (organic acids and siderophores) implicated in solubilizing Pb-PO_4 phases such as pyromorphite.

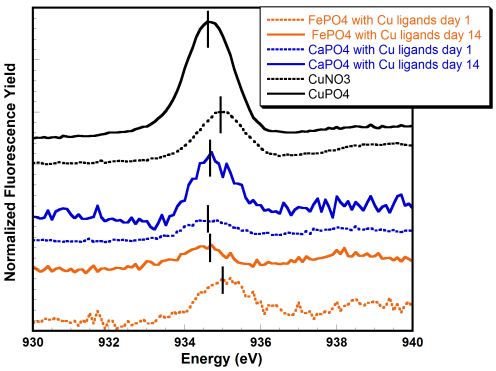

Fig.1: Stacked Cu(II) L-edge XANES spectra (collected at Synchrotron Radiation Center (Stoughton, WI)) for Cu(II) standards and 1mM Cu(II) added to Fe- and Ca-PO_4 nanoparticlesin the presence of citrate and DFO-B.