Characterization of Fe(0) electro-coagulation reaction products using synchrotron-based techniques

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Electrocoagulation (EC) using Fe (0) electrodes is a promising technology capable of cheaply and efficiently removing arsenic from drinking water. In EC, an electric current is applied to Fe (0) electrodes inserted into pumped groundwater contaminated with arsenic. Electrolysis of the Fe (0) anode leads to the *in situ* formation of iron (oxyhydr)oxides, which form surface complexes with arsenic. Of concern in such systems are common groundwater constituents (PO_4^{3-}, SiO_2, Ca^{2+}, Mg^{2+}), which can influence the structure of the generated precipitates in both subtle and complex ways. To assess the influence of these ions, synchrotron-based techniques were used to characterize EC precipitates generated in chemically varying electrolytes. Electrolytes were chosen to clarify the individual effect of strongly-adsorbed ions (0.5mM Na_2HPO_4, 0.75mM SiO_2) and weakly-adsorbed ions (1mM $CaCl_2$, 1mM $MgCl_2$, 2mM NaCl) on the removal of 1μM As(V) at pH 7.5. The As K-edge XANES and EXAFS spectra of precipitates generated in the Na_2HPO_4 electrolyte differed in both phase and line shape from those of precipitates generated in the NaCl and $CaCl_2$ electrolytes. These differences likely reflect a change in the adsorbent structure due to sorption of the surface-poisoning PO_4^{3-} oxyanion. The Fe K-edge EXAFS spectra and PDFs of similar samples will be presented to provide complementary views of the adsorbent structure (phase, crystallite size, and degree of FeO_6 octahedral polymerization) in instances where variations in the As K-edge spectra were observed. These results provide an important molecular-scale understanding of arsenic removal during EC.

On the way to medical diagnosis based on the isotopic analyis of metabolically relevant transition metals

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Although modern medicine already has many sophisticated tools for the diagnosis of a large variety of diseases, there are still diseases for which diagnosis is difficult or can only be accomplished at a later stage of progression. New diagnostic tools are therefore highly needed for drawing unequivocal conclusions or start medicating people at an earlier stage.

A promising approach for diagnosis is the isotopic analysis of elements the metabolism of which is affected by the disease (e.g. Fe)[1]. Next to Fe, also Zn and Cu are important transition metals because of their great catalytic, structural and regulating importance in the human body [2].

These non-radiogenic elements show natural variations in isotopic composition due to isotope fractionation. As a result, we aim at developing a minimally invasive method, based on isotopic analysis using MC-ICPMS. In the method developed for this purpose Cu, Fe and Zn were isolated from blood within the same chromatographic separation with quantitative recovery, thus avoiding the effect of on-column isotope fractionation. External precisions for this method are 0.02; 0.05 and 0.03 ‰ (2s) for $\delta^{56}Fe$, $\delta^{66}Zn$ and $\delta^{65}Cu$, respectively. A first sample set comes from supposedly healthy human volunteers (reference population, including vegetarians and 'omnivorous) to investigate the dependence of isotope composition and nutrition. Whole blood from patient populations will be investigated at a later phase.

[1] Krayenbuehl (2005) *Blood* **105**, 3812–3816. [2] Walravens (1979) *Western J of Medicine* **130**, 133–142.