ESRF Experimental Report

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Proposal Title

Cobalt and silver speciation in radio-tolerant green micro algae for environmental bioremediation

Experimental Team

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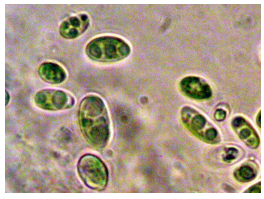
Samples (Biological)



Coccomyxa actinabiotis cells grown in metallic solutions (Ag, Co, U), centrifugated, then kept in *l*-N_2 .

Methodology

Samples are macroscopic and the beam is mm^2 sized. Sample temperature is 15 K. XANES and EXAFS data sets are analysed using Feff and a least-square fit procedure.

Results: Silver enriched algae

Samples prepared with [Ag] = 10^{-3}, 10^{-4}, 10^{-5} M and 10^{-6} M $AgNO_3$ solutions have been acquired for XANES and EXAFS data analysis around the silver 26 keV K-line. The initial silver solution concentration ranged from pH=3.5 to 4.7 for 10^{-2} to 10^{-5} M respectively. However, the internal pH in algae is probably slightly different. The 10^{-6} M sample has too low statistics, and has been discarded. All other samples indicate that silver is sequestrated in pure metallic state Ag^0. Reference samples of silver metal foil, and $AgNO_3$ solution have also been measured for calibration purposes. The EXAFS data analysis is still under processing.

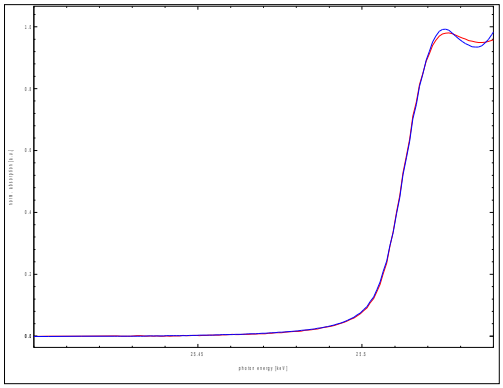


Figure 1: Silver XANES around 26 keV K line, for alage enriched in [Ag]=10^{-3} M. Data is in red, fit is in blue.

Results: Uranium enriched algae

The XANES data indicates that Uranium is in its +IV oxidation state. The EXAFS data exhibits a first U-O axial shell R=1.79 Å, typical for uranyl ions. Second and third shells correspond to U-O equatorial bonds R=2.34 and 2.49 Å ("split equatorial shell") which suggests that two oxygen atoms are arranged in a bidentate formation.

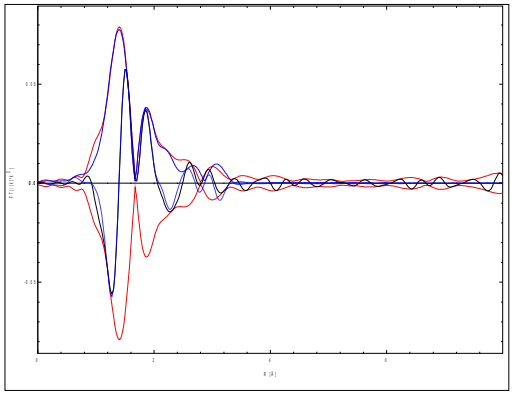


Figure 2 : Uranyl EXAFS for U enriched algae. Data is in red, fit is in blue.

Results: Cobalt enriched algae

The data set acquired for Cobalt enriched algae has very low statistics, as well as the reference spectra for Co^{II} and Co^{III}. Moreover, they do not extend far enough in energy in order to be used for accurate XANES analysis. It is clear from these results that additional acquisition time is needed to determine the oxidation state and local cobalt atom surroundings geometry.

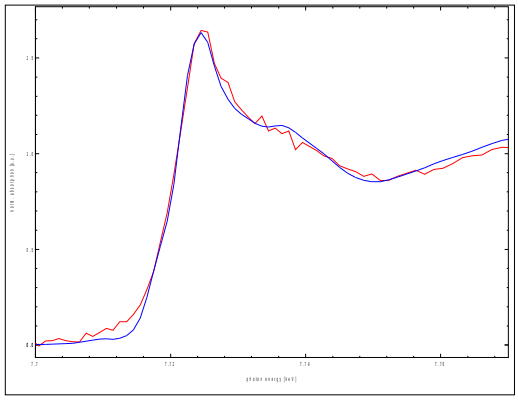


Figure 3: Cobalt XANES edge for Co enriched algae. Data is in red, fit is in blue.