Theme 1. Exposure: Transport and Transformations

Redox Transformations of Ag NPs in the Environment

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Reason for research

My research focuses on transformation and reactivity of nanoparticles. One project of mine is to investigate oxidative dissolution of silver nanoparticles. Silver nanoparticles (Ag NPs) are wildly used in consumer products because their bactericidal effects. Inevitably, the Ag NPs enter environment and pose a potential risk on human and other species. This research will help us to understand fate and transformation of nanoparticles (Theme 1) and will also provide useful information for Theme 2 and 3.

Hypothesis

Dissolution of Ag NPs will be enhanced by some ligands. For example, as shown in the below picture, on the right part of the picture, Ag NPs is not oxidized (or is very slowly oxidized) with only dissolved oxygen (bubbled air). However, with sulfide presents, the dissolution rate of Ag NPs is greatly increased proved by transparent solution and black precipitation (silver sulfide) at the bottom of the left beaker. Hence, in different conditions, transformation rates of Ag NPs are expected to differ.

Approach and Results

Dynamic light scattering will be utilized to measure size of particles. Synchrotron XAS will be used to determine chemical composition of NPs. Atomic Absorption spectrum coupled with Graphite Furnace and UV/VIS will be used to detect concentration of nanoparticles and dissolved species.

Implications

After we know what are the dissolution rates of Ag NPs in different environment conditions. We will be able to predict lifetime and ultimate fate of Ag NPs in environment. We can answer questions like ‘Will certain Ag NPs still persist in aquatic environment 2 years after released?’ ‘What forms will Ag NPs be in after released to environment certain time?’ and so on.