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Investigations into the environmental transformations of silver nanoparticles

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Silver nanoparticles (Ag-NPs) constitute a major group of engineered nanomaterials increasingly found in consumer products. These products exploit the unique properties of Ag-NPs such as their antibacterial effects, special optical properties, and high specific surface area and reactivity. However, there are significant concerns regarding the potential for Ag-NPs to pose equally unique risks upon their release to the environment. For example, Ag-NPs may have direct ecotoxicological effects, and they may also release ionic Ag, which is highly toxic to a range of organisms. As AgNP toxicity, dissolution, and speciation are likely to change in response to the surrounding environmental conditions, understanding the transformations of Ag-NPs in major release pathways and environmental endpoints is critical to assessing their potential risks.
To this end, we have developed a series of nano in situ deployment devices (nIDDs) and used them to investigate the transformations of Ag-NPs in a range of environments. Following in situ deployment, during which the Ag-NPs on the nIDDs were directly exposed to relevant environments, the devices were retrieved and X-ray Absorption Spectroscopy (XAS) was used to determine the speciation of the exposed Ag-NPs. This revealed that Ag sulfide NPs are major transformation products forming from Ag-NPs in a wide range of environments. Subsequent XAS-based research showed that Ag sulfide is a stable, long term species of Ag reaching major environmental endpoints such as soil, which mitigates the potential ecological risks posed by the environmental release of Ag-NPs.

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Summary

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