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Transformation of silver nanoparticles in the environment

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The transformation of manufactured nanoparticles under natural conditions is a challenging area of research due to the environmental low concentrations that can be expected at present time. We have investigated the transformation of nanoparticles from consumer products and along the wastewater, biosolid soil pathway using a range of approaches. For instance, we developed and tested a nano in situ deployment device (nIDD) in which plasma polymerization is used to immobilize Ag-NPs on a substrate which allows us to analyse, through XANES, nanoparticles upon exposure and retrieval in/from different complex environmental compartments. These devices can be constructed in a variety of ways to cater for the research question of interest. In the examples reported here, plasma polymerization was used to immobilize the Ag-NPs on polyimide tape for XANES analysis and on Si wafers for XPS investigations. The nIDDs were exposed to a range of environmental conditions including a freshwater lake, a marina, freshwater and saltwater sediments, a sewer system and to the atmosphere in a number of cities in Australia, Europe and the US. Exposure time varied from few hours (sewer system) to a few weeks (air exposure). In the technological and environmental compartments the chemical and physical conditions play a dominant role in determining Ag speciation. Complexation of Ag by reduced sulfur groups was the key transformation mechanism but variability existed within various compartments. Further development is ongoing to integrate nIDDs with other devices to expand their use beyond speciation assessment and to NPs other than Ag.

Keywords

Silver, nanoparticles, transformation, environment, XANES

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