South Carolina Researchers Study the Environmental Behaviors of Platinum Nanoparticles

Researchers from the Arnold School of Public Health's Environmental Health Sciences Department and the South Carolina SmartState Center for Environmental Nanoscience and Risk at the University of South Carolina have collaborated with a scientist from the National Center for Earth and Environmental Nanotechnology Infrastructure to study the synthesis, characterization, and environmental behaviors of platinum nanoparticles. The resulting paper was published in the Journal of Colloid and Interface Science.

The release of platinum group elements, including platinum nanoparticles, has been increasing over recent decades. However, few studies have investigated the fate, behavior and effects of these nanoparticles in environmental media.

With this study, the researchers report a protocol for the synthesis of five different sizes (8.5 ± 1.2, 10.3 ± 1.3, 20.0 ± 4.8, 40.5 ± 4.1, and 70.8 ± 4.2 nm) of monodispersed citrate- and polyvinylpyrrolidone (PVP)-coated PtNPs, together with a characterization of their behaviors in relevant biological and toxicological media.

In general, platinum nanoparticle sizes measured using dynamic light scattering, field flow fractionation, single-particle inductively-coupled plasma-mass spectroscopy, transmission electron microscopy and atomic force microscopy, were all in good agreement when their sizes were larger than the size detection limits of each analytical technique. The authors found slight differences in sizes measured were attributable to differences in analytical techniques, measuring principles, nanoparticle shape and nanoparticle permeability. The thickness of the PVP layer increased (from 4.4 to 11.35 nm) with increases in NP size.

Further, the critical coagulation concentration of cit-platinum nanoparticles was independent of nanoparticle size, possibly due to differences in surface charges as a function of nanoparticle size. Platinum nanoparticles did not undergo significant dissolution in any media tested.

Platinum nanoparticles did not aggregate significantly in Dulbecco's modified Eagle's medium; but they formed aggregates in moderately hard water and in 30 ppt synthetic seawater, and aggregate size increased with increases in PtNPs concentration. Overall, this study describes a general model naoparticle system (i.e., platinum nanoparticles) of different controlled nanoparticle sizes and coatings that is predictable, stable and useful to investigate the fate, behavior, uptake, and eco-toxicity of nanoparticles in the environment.