PROJECT FACTS

UNIVERSITY OF KENTUCKY CENTER FOR APPLIED ENERGY RESEARCH

CLEAN FUELS & CHEMICALS

Assessing the Bio-distribution and Nanotoxicology Effects of Engineered Nanoparticles

PARTICIPANTS

University of Kentucky
University of Louisville

SPONSORS

EPA (STAR)

PROJECT VALUE

$2 Million

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Nanoparticles are powerful catalysts and are used together with nanoscale support structures (oxides, carbides and carbon nanotubes) for energy applications. They are constructed at atomic and molecular levels and as such have already been shown to technologically transform a wide range of materials and devices. But there are also unknowns about nanoparticle exposure. Current scientific evidence demonstrates that certain nanoscale materials have a potential toxicity towards human, animal and environmental systems, yet there is no adequate environmental impact assessment in place.

UK and UofL have a collaborative effort underway on the potential health impacts of nano-sized ceria. The work is based on research performed at CAER, the Departments of Pharmacy, Chemistry and Chemical Engineering at UK as well as The Dept. of Experimental Pathology at the University of Louisville. The project is funded by a 2 million dollar EPA (STAR) Grant (PI: Dr. Robert Yokel, Pharmacy). The objective at CAER is to synthesize and characterize nanoscale ceria (CeO_2), its bio-distribution from blood, and its effects on oxidative stress endpoints. CAER's role is instrumental in providing ceria nanoparticles with a defined size, shape and oxidative potential to help identify the properties that influence their distribution into organs and particularly the brain. The bio-distribution study in rat tissues is assessed by high-res transmission electron microscopy and ICP-AES/MS. The oxidative stress effects are then assessed by protein-bound 4-hydroxy 2-*trans*-nonenal (HNE), protein-bound 3-nitrotyrosine (3-NT), and protein carbonyls (Butterfield Group, Chemistry and Center for Membrane Sciences).

Since ultra small ceria is thought to target peripheral organs and possibly penetrate the blood brain barrier, CAER receives stabilized tissue materials for STEM and EELS determinations of the ceria nanoparticles after bio-distribution. Controlled nanoparticle characterizations before and after bio-distribution, linked with the physiological responses, provide a foundation for evaluating the effects of engineered nanomaterial physico-chemical properties on peripheral organ distribution, brain entry and resultant toxicity.