# New ORNL process brings nanoparticles into focus

June 23 2008

Scientists can study the biological impacts of engineered nanomaterials on cells within the body with greater resolution than ever because of a procedure developed by researchers at the Department of Energy's Oak Ridge National Laboratory.

The method, detailed in the current issue of Nature Nanotechnology, uses scanning near-field ultrasonic holography to clearly see nanoparticles residing within cells of laboratory mice that had inhaled single-walled carbon nanohorns. Nanohorns are short, horn-shaped tubular structures capped with a conical tip.

"While carbon-based materials have countless potential uses, we need to know how they interact within a cell - and whether they are able to penetrate cells," said Laurene Tetard, lead author and a member of ORNL's Biosciences Division. "We found that these nanohorns can indeed get into cells."

With this new tool, researchers will be able to determine whether a cell's shape changes because of nanomaterials such as the nanohorns used for this study. Tetard and co-authors expect this work to be of significant benefit to scientists studying drug delivery systems, nanotoxicology and interactions between engineered nanomaterials and biological systems.

"The rising commercial use of engineered nanoparticles and the ensuing need for large-scale production pose a risk of unintended human exposure that may impact health," the authors wrote. "Central to this

issue is the ability to determine the fate of nanoparticles in biological systems and in more details their route after inhalation."

In contrast to conventional imaging techniques, scanning near-field ultrasonic holography provides a detailed look inside a cell, providing nanometer resolution.

"Conventional atomic force microscopy using a cantilever tip can only probe the surface of a specimen, making it difficult to analyze structures that are inside a cell," Tetard said. "Our method benefits from all of the advantages of a standard atomic force microscope but provides access to some of the features buried inside the cell."

Ultimately, this new imaging capability could help advance the field of nanoparticles-cell interactions. In addition to the high-resolution subsurface imaging and localization of nanoparticles in biological samples, scanning near-field ultrasonic holography allows for minimal sample preparation and requires no labeling with radioisotopes. The technique also offers relatively high throughput sample analysis, which enables researchers to image many cells quickly.

"The scanning near-field ultrasonic holography method should be especially useful for determining the efficacy of cell type-specific drug targeting, which is a critical goal for medical uses of nanomaterial," wrote the authors, who expect their results to help resolve critical questions about the fate and potential toxicity of nanoparticles within the body.

Source: Oak Ridge National Laboratory