PerkinElmer and Missouri S&T Collaborate on Nanoparticle Study

NexION 350 ICP-MS with Syngistix Nano Application Module are Game Changers for Nanoparticle Research

Imagine creating a completely new world of manmade particles that could revolutionize every facet of science, lead to extraordinary advances in engineering and technology, and profoundly affect the lives of everyone on Earth. Now, picture that new world of engineered nanoparticles called ENPs fitting very comfortably on the head of a pin.

Welcome to nanotechnology, the study and control of matter measured in nanometers. To provide a sense of just how small that is, a nanometer is one billionth of a meter, an inch contains 25.4 million nanometers, and the diameter of a single human hair measures roughly 100,000 nanometers wide.

While nanotechnology operates on an extremely small scale, its global impact is nearly incalculable. Gases, liquids, and solids in nanoscale exhibit novel properties and applications not seen at larger sizes. Some materials are stronger. Others are more chemically reactive or reflect light differently. Still more have different physical, biological, or magnetic properties than in other forms or sizes of the same material. The sum result of those novel properties is a global market for ENP-made products that experts predict will exceed $3 trillion by 2015. From cosmetics and medical therapies to stronger plastics and even the computer screen you are likely using to read this story—there are nearly a thousand products already on the global market that owe their existence to ENPs and countless more are on the way.
Innovative Partnership Addresses Urgent Priorities

As with any new field of study, nanotechnology and the creation of ENPs may pose unintended environmental, health, and safety risks demanding further study. The traditional research process involving nanomaterials, however, requires many different types of technologies, including electron microscopes, great technical expertise, hours of manual calculations, and considerable investments in research to obtain a single piece of information. Given the vast array of nanoparticles in development, some scientists say that it is doubtful that all ENPs will be thoroughly tested for a wide range of environmental effects before allowing their use

Others are pushing policymakers to adopt the “precautionary principle.” In the absence of scientific consensus, they argue that the burden of proof that something is not harmful is on those who create it. Critics claim such a position is overly conservative and will block real innovation and progress.

Fortunately, a major new technology is available that significantly improves the research quality and time needed to detect, quantitate, and characterize nanoparticles. The NexION® 350 ICP-MS (Inductively Coupled Plasma Mass Spectrometer) by PerkinElmer, a global force in life and environmental health sciences, measures nanoparticles ten times faster than any other ICP-MS on the market. Thanks to a collaborative agreement with Missouri University of Science & Technology (Missouri S&T), a longtime PerkinElmer customer and emerging presence in nanotechnology research, the NexION 350 is helping university scientists to develop Single Particle ICP-MS methods for characterizing novel ENPs, investigating how they work, and determining their toxicity levels.

NexION 350 and Syngistix Offer Real-Time Advantages

“The NexION 350 ICP-MS opens up a whole new world of efficiency and opportunity for nanoparticle analysis,” says Dr. Honglan Shi, Associate Research Professor of Chemistry at Missouri S&T and lead researcher on the project. “We can measure nanoparticles in less time, with accurate characterization, using a dedicated easy-to-use software interface.”

That interface, called the Syngistix™ Nano Application Module, is the world’s first single particle ICP-MS-dedicated analysis software offering speed, flexibility, and automation. It can determine everything from particle composition and concentration to size and distribution in a single run in less than one minute without the need for additional labor-intensive data processing.

According to Dr. Shi, the NexION 350 ICP-MS can detect a number of ENP parameters simultaneously, including their size, distribution, as well as both particle and dissolved element concentrations. It can also discover agglomeration — groups of nanoparticles that are stuck together — and is able to confirm manufactured versus naturally occurring particles. “What is really unique about the instrument is that it can find ultra-low concentrations of ENPs in real environmental and biological samples,” Dr. Shi says.

Dr. Xinhua Liang, Assistant Professor of Chemical and Biochemical Engineering at Missouri S&T and a fellow member of the research team, is creating multi-element ENPs as measurement and reference materials for the project using advanced atomic layer deposition (ALD) technology. ALD is best known for its ability to bond high quality, thin films of materials based on varying pulses of chemical vapors reacting with different surfaces. Dr. Liang is using ALD to deposit metal oxide film coatings on the ENPs “to precisely control the composition of the ENPs and provide high quality, well-characterized multi-element ENPs as calibration standards,” he says. “ALD is an ideal technique to prepare such multi-element ENPs.”

Drs. Shi and Liang are among a number of Missouri S&T researchers investigating the multi-element capabilities of nanoparticles and engineering their own physically uniform ENPs for research use in biologics, petroleum, fuel cells, semiconductors, nanomedicine, and nanotox research.

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**Strong PerkinElmer Connection**

“Over its 15-plus-year relationship with PerkinElmer, Missouri S&T has built an impressive laboratory and incredible display of classification tools,” says Heidi Grecsek, Regulatory and National Account Leader for PerkinElmer, explaining that the company is providing the university with use of the NexION 350 ICP-MS.

“Getting a good, fast characterization of nanomaterials in a variety of complex matrices has hindered researchers as well as industry,” she notes. “This technique, where nanoparticles are quickly analyzed in less than a minute, and in large batches, will take the industry a long way.”

“We modified our instrument to run nanoparticles data in real time,” says Dr. Chady Stephan, Manager of Global Applications at PerkinElmer, who led a series of advanced training sessions on the equipment for Missouri S&T researchers and students. “This analysis of a single nanoparticle is a new application of the ICP-MS.”

Missouri S&T’s Dr. Shi agrees. “This instrument greatly enhances our current research projects and opens up many new findings and research opportunities,” she says, adding “many more Missouri S&T students will be trained on PerkinElmer’s cutting-edge technology in the years to come.”

Equally important, says PerkinElmer’s Heidi Grecsek, is the fact that this collaboration is meant to promote both public and business initiatives to protect the safety of people and the environment as well as advance science, technology, and the quality of life everywhere. “We think scientists in academia, business, and regulatory agencies who need to understand the lifecycle of nanoparticles will benefit greatly from the advances that the NexION 350 ICP-MS and Syngistix Nano Application Module offer. They are game changers.”

**Research Implications are Far Reaching**

Dr. Stephan says that Missouri S&T’s research could well have public health implications, as the NexION 350 ICP-MS can be used to detect nanoparticles in drinking water. “In just one minute after testing a water sample, you would know if there were any nanoparticles present,” he says, adding that other methods available would take several hours between sample preparation and analysis.

References