MPLUS+

Real-Time Characterization Project Addresses a Priority Need in Nanomanufacturing

The two main industry groups that provide input to the National Nanotechnology Initiative – the Chemical Industry Vision2020 Technology Partnership (Vision2020) and the Semiconductor Research Corporation (SRC) – recently joined forces to define common, priority R&D needs for accelerating commercialization of nanotechnology. Their study, *Implementation Plan for Chemical Industry R&D Roadmap for Nanomaterials by Design* was released in April, 2006.

Mengdawn Cheng of ORNL and Emory Ford of MTI operate a differential mobility analyzer.

A key research are need identified by both industries is the capability for real-time characterization of nanoparticles smaller than 50 nanometers during synthesis processes. According to the industry experts, the techniques currently used either lack the accuracy needed, or are not suitable for in-plant operation. Thus, there is often an inadequate ability to monitor and control production processes for nanoscale materials, resulting in variability in product quality.

The Industrial Technologies Program (ITP) has recognized the emerging needs in nanomanufacturing, and initiated a Materials Processing Laboratory Users (MPLUS) project to address the need for real time characterization. Emory Ford of Materials Technology Institute (MTI), a major contributor to the Vision2020-SRC efforts, identified the specific characterization problem, and a multidisciplinary team of R&D experts at Oak Ridge National Laboratory (ORNL) – including chemical engineers, physicists, microscopists, materials scientists, and aerosol scientists – was assembled to demonstrate a promising characterization technique.

The commercial differential mobility analyzer instruments are portable and capable of in-plant operation.

A commercial differential mobility analyzer, which employs the deflection of charged particles in an electric field to segregate particles in a gas stream by electrical mobility size, was used to sample and characterize in real time the nanoparticles produced in two different types of gas-phase processes: a chemical vapor deposition process for production of metal-oxide particles, and a laser-ablation process for synthesis of carbon nanomaterials.

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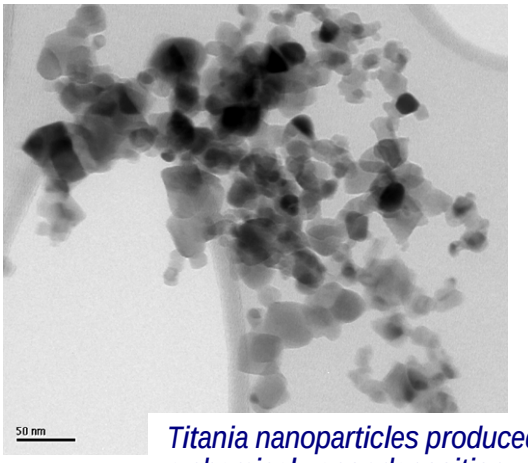
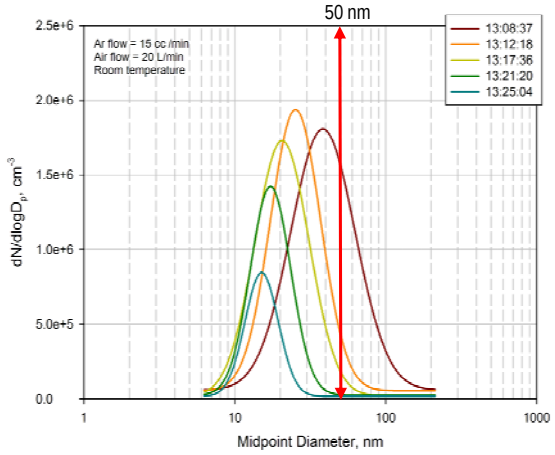
Various process parameters, including precursor feed rate and furnace temperature were investigated, and the impact on the size distribution of the nanoparticles that were produced was observed in real time using this equipment. The results of the particle size distribution analysis for particles below 50 nm were consistent with those determined from by microscopic analysis. The potential capability of the analyzer to provide real-time data on the variation of the particle size distribution was demonstrated. The results indicated promising opportunities for rapid detection of process transients, and for the use of the instrument in process development.



Titania nanoparticles produced in a chemical vapor deposition furnace. Size bar is 50 nm.



Real-time sampling and analysis detected a shift in particle size distribution in the sub-50nm range during a transient in process conditions.

The success of this industry-national laboratory collaborative project to address an urgent, widespread need in nanomanufacturing indicates the value of the MPLUS effort. The results of this work have been submitted to a peer-reviewed journal.

For more information on this project please contact;
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