thermo scientific

Automated large area image and analytical data acquisitions at high resolution with on-the-fly processing

Utilizing the innovative Maps and Avizo Software

Nanotechnology offers the food and cosmetics industry a number of new approaches for improving the quality, shelf life, safety, and healthiness of foods. Nevertheless, there is concern about potential adverse effects associated with the application of nanoparticles in such products.

The science of characterizing nanoparticles involves exploring and manipulating structures at the nanoscale, where dimensions range between 1 to 100 nanometers, to enhance the properties of everyday materials. Under-standing the potential positive and negative impacts of nanoparticles on our health and product safety is critical to informing both our scientific choices as well as providing a basis for regulatory oversight.

Quantifying the composition, sizes and shapes of nanoparticles in these everyday objects is a crucial first step in furthering our understanding of the relationships between nanoparticles, quality and safety.

While the concept of nanotechnology has been around for decades, the recent explosion can be attributed to easier-to-use, more automated, high-resolution microscopes and increasingly powerful computers that can very rapidly reconstruct and analyze the data. Using intuitive scanning or transmission electron microscopes (S/TEM) like the Thermo Scientific™ Talos™ in combination with energy dispersive x-ray spectroscopy (EDXS) researchers around the globe are obtaining nanometer- and even subnanometer-scale images and chemical data which give important insights into the arrangement and potential functions of nanoparticles.

The need for large area correlative imaging at high resolution has increased recently because it allows researchers to preserve the context of their observations while also providing statistically robust data. Our Maps™ software, enabled by Velox™, automatically acquires an array of images across a sample and stitches them together to create one large final image. The acquisition of the images can be done unattended. Our Avizo™ Software allows researchers to perform image analysis via automated workflows for on-the-fly processing and generating statistics such as size, surface area, perimeter, distribution, and chemical composition of nanoparticles. Images and chemical information from different microscopes can be correlated to keep the relevant context.

As nanotechnology-based products start to proliferate, their safety and environmental impacts are being studied. One area of research involves exploring the health impacts of nanoparticles used to enhance food and cosmetics—including titanium dioxide, silver, and gold. The goal is to formulate a standard approach to identify and characterize the concentration of nanoparticles in food additives and determine the volume of nanoparticles that are safe for human contact and consumption. Automated and unattended workflows will enable even researchers unfamiliar with TEM technology to generate quality data to help build the future of the safety and regulatory questions related to nanoparticles.

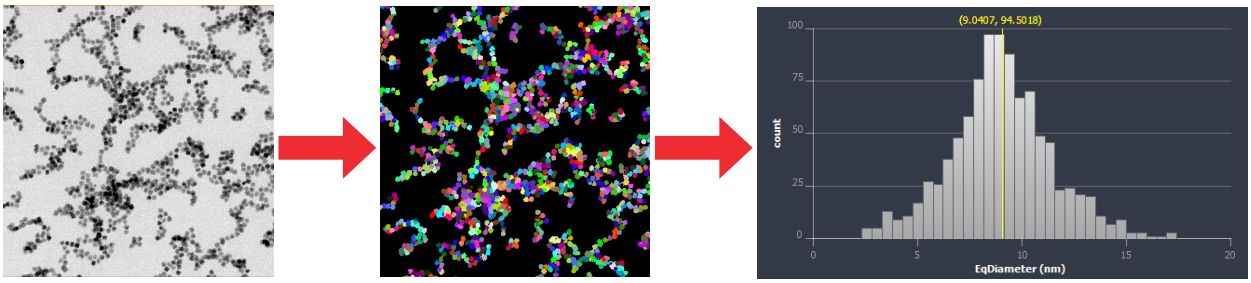

Figure 1. Automated, large-area STEM acquisition using Maps, Velox, and Avizo Software in Talos TEM systems for individual particle parameter analysis. *Sample courtesy of Prof. B. Gorman and Prof. R. Richards, Colorado School of Mines.*

ThermoFisher SCIENTIFIC

thermo scientific

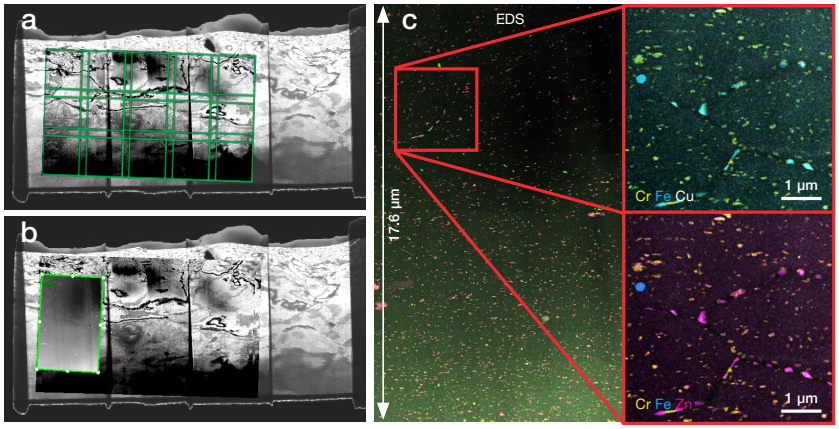

Figure 2. Large-area STEM and EDS at high resolution: (a) 3x5 tiles stitched LM-STEM, (b) 7x11 tiles stitched STEM maps and EDS maps with total area of 17.6x11.3 µm and a few nm resolution. Individual tiles can be set up to contain even more tiles to increase the resolution, and (c) digital zooms of (b). *Samples courtesy of University of Manchester & University of Trento.*

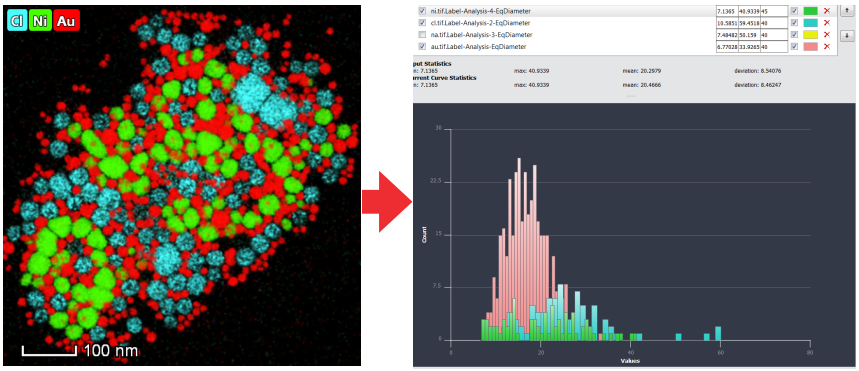

Figure 3: Automated, large-area STEM-EDS data processing (per element) with Avizo Software. *Sample courtesy of J. Bursik, Institute of Physics of Materials, Brno.*

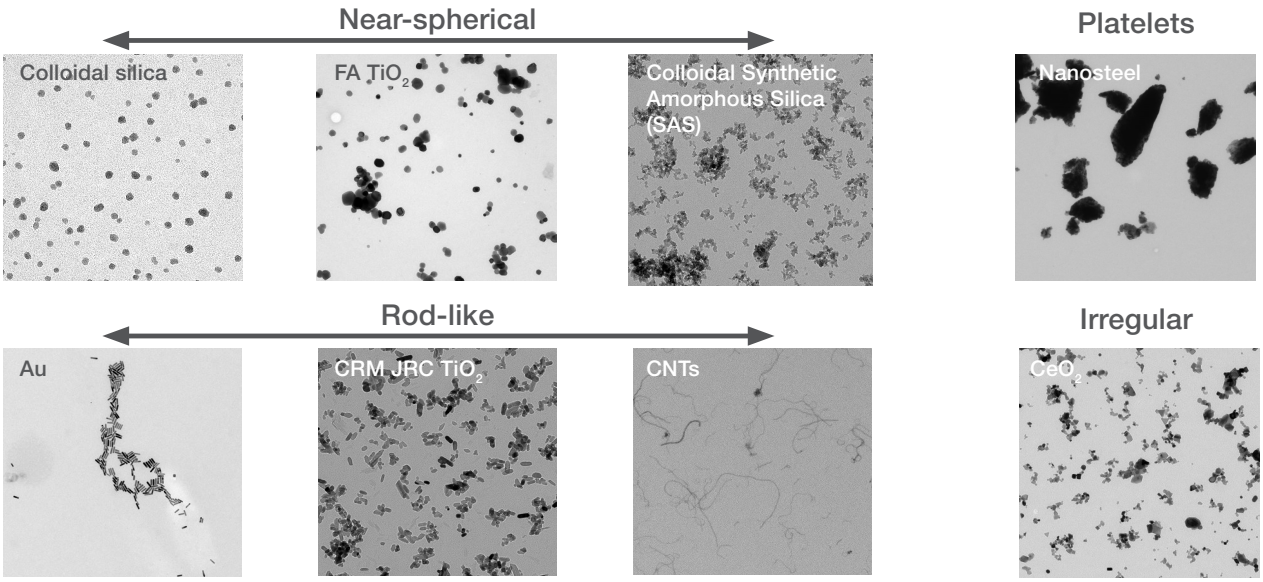

Figure 4: Examples of nanomaterial morphologies characterized by Talos (Scanning) Transmission Electron Microscope. *Images courtesy of Sciensano, Brussels, Belgium.*

Find out more at **thermofisher.com/EM-sales**

ThermoFisher SCIENTIFIC