LOOKING INSIDE NANOMATERIALS IN 3-D

May 17, 2011 — Scientists from Denmark, China and USA have developed a new method for revealing 3-D images of the structure inside a material.

Most solid materials are composed of millions of small crystals, packed together to form a fully dense solid. The orientations, shapes, sizes and relative arrangement of these crystals are important in determining many material properties.

Traditionally, it has only been possible to see the crystal structure of a material by looking at a cut surface, giving just 2-D information. In recent years, x-ray methods have been developed that can be used to look inside a material and obtain a 3-D map of the crystal structure. However, these methods have a resolution limit of around 100nm (one nanometer is 100,000 times smaller than the width of a human hair).

In contrast, the newly developed technique now published in the journal *Science*, allows 3-D mapping of the crystal structure inside a material down to nanometer resolution, and can be carried out using a transmission electron microscope, an instrument found in many research laboratories.

Samples must be thinner than a few hundred nanometers. However, this limitation is not a problem for investigations of crystal structures inside nanomaterials, where the average crystal size is less than 100 nanometers, and such materials are investigated all over the world in a search for materials with new and better properties than the materials we use today.

For example, nanomaterials have an extremely high strength and an excellent wear resistance and applications therefore span from microelectronics to gears for large windmills. The ability to collect a 3-D picture of the crystal structure in these materials is an important step in being able to understand the origins of their special properties.

An important advantage of such 3-D methods is that they allow the changes taking place inside a material to be observed directly. For example, the mapping may be repeated before and after a heat treatment revealing how the structure changes during heating.

This new technique has a resolution 100 times better than existing non-destructive 3-D techniques and opens up new opportunities for more precise analysis of the structural parameters in nanomaterials.