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3D Orientation mapping in the transmission electron microscope – 3D-OMiTEM

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Nanocrystalline materials (i.e. polycrystalline aggregates where the individual crystallites/grains or particles have sizes below 100 nm) are formed through various processes ranging from mechanical treatments of bulk materials, to electrodeposition of thin films and coatings to aggregation of nanoparticles. The materials constitute one of the most rapidly growing new classes of materials and exhibit enhanced properties, ranging from high strength and wear resistance, to unique functional characteristics, which open up a large spectrum of applications e.g. for micro- and nano-electro-mechanical systems (MEMS and NEMS). Methods using the Transmission Electron Microscope (TEM) such as electron tomography and electron holography may provide 3D information isolated particles on the nm-scale, but these methods are not applicable for 3D mapping of bulk nanocrystalline materials composed of large number of nanograins or nanoparticles. Consequently, materials models tend to be based only on simple observables such as a 2D crystalline projection or an average grain/particle size. Motivated by this, a new and non-destructive technique called "3D-Orientation Mapping in Transmission Electron Microscope" (3D-OMiTEM) was developed and it was demonstrated that both orientation and 3D morphology of ~1000 individual nanograins could be measured with spatial and angular resolutions of 1 nm and 1 degree. The method utilizes conical dark field scanning mode for data acquisition, where images are collected over a wide range of beam and sample tilts. The methodology of 3D-OMiTEM is presented along with examples and potential applications.

Biography

S Schmidt obtained his PhD in Physics from the Niels Bohr Institute at the University of Copenhagen, Denmark in 2000. He is currently Senior Scientist at the Department of Physics at the Technical University of Denmark as well as Guest Professor at Chongqing University in China. Over the past 14 years he has developed several non-destructive characterization techniques utilizing x-rays, electrons and neutrons. He has published 69ISI articles, two in Science. In 2012, he received the Microscopy Today Innovation Award.

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