

X-ray scattering – a tool for the characterization of nano-structured materials

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Nano-structured and advanced thin-layered materials show novel, controllable optical, mechanical and transport properties that enable the design of new electronic, optical, mechanical and energy devices. Typical materials involved are nano-sized powders, semiconductors, metal alloys, dielectrics and also polymers. The necessary scaling of the applied structures challenges the synthesis and processing as well as the characterization tools. A detailed knowledge of the material properties is important for its application and crucial for further development and improvements.

X-ray techniques provide great potential not only in the research and development phase, but also offer unique options for process development and monitoring. A variety of X-ray scattering methods, including X-ray diffraction (XRD) and Small Angle X-ray Scattering (SAXS) have been successively used for material characterization and structural analysis. From X-ray scattering data structural information is extracted to identify and quantify phases, to determine composition and strain profiles, thickness, roughness, density, grain size, residual stress and preferred orientation.

This presentation will give an overview on the experimental aspects, including recent hardware developments and evaluation processes of X-ray scattering methods. Examples of technologically relevant materials will be used to demonstrate the high potential of X-ray techniques.

Author Profile

Dr Milen Gateshki is a Senior Application Specialist X-Ray Diffraction at the Applications Competence Centre of PANalytical BV in Almelo, the Netherlands.

His expertise includes X-ray and neutron diffraction, Rietveld refinement and pair distribution function (PDF) analysis, structural studies of nanocrystalline and highly disordered materials, phase transitions, crystallographic symmetry, microstructure analysis, structure modeling, sample preparation and thermal properties.

Milen received his M.S. degree in Solid State Physics from Sofia University (1995) with a thesis on thermal properties of ternary chalcogenide glasses. His PhD in Materials Science and Technology (2003) is from the **Department of Applied Physics of the University of the Basque Country** - home of the Bilbao Crystallographic Server. Milen's thesis was dedicated to the experimental and theoretical study of the structural phase transitions occurring in a number of double perovskite oxides. After finishing his PhD he joined the Department of Physics of Central Michigan University as a postdoctoral associate (2004-2007). During this period his research was dedicated to structural studies of nanocrystalline materials with applications in electrochemical power sources, catalysts, functional ceramics, and others.