

Small-and wide-angle X-ray scattering (SAXS/WAXS) in materials science

Corresponding author:

Petr Bělský, pbelsky@ntc.zcu.cz, University of West Bohemia, New Technologies - Research Centre

Abstract:

Small-angle X-ray scattering (SAXS) is a well-established characterization method for microstructure (in particular, nanostructure) investigations in various materials. It examines electron density differences to provide information about structural inhomogeneities, particles or pores with size from the near atomic scale (~ 1 nm) to the scale of tens or at maximum around 200 nm in case of desktop SAXS instruments or up to micron scale (at maximum ~ 15 μm) in case of synchrotron SAXS instruments. Wide-angle X-ray scattering (WAXS) experimental setup is usually similar to that of SAXS – the difference is that the X-ray scattering/diffraction under higher scattering angles is examined. WAXS gives information about sub-nanometer-scale structure of material, i.e., crystallinity/amorphousness. At New Technologies – Research Centre (NTC) of the University of West Bohemia, SAXSess instrument by Anton Paar (Austria) is available in a configuration enabling to investigate nanostructures on the scale from approximately 1 to 25 nm. The SAXS/WAXS method, its possibilities and the applications of SAXS/WAXS in materials science will be introduced in general. Our SAXSess instrument and selected applications for which the method was applied at NTC so far, will be presented. It includes e.g. investigation of nucleation of a new phase in metakaolin, structure analysis of Nafion-based polymer membranes and other membranes for hydrogen fuel cells and vanadium redox batteries, polyvinyl alcohol-based membranes, and analysis of size distribution changes of Pt catalysts in fuel cells after operational tests.

Key words:

SAXS, WAXS, materials science