Characterization of defect structure in nanocrystalline ceramics by X-ray diffraction line profile analysis

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The type and densities of lattice defects (e.g., dislocations, stacking and twin faults) have a significant effect on the functional properties of nanocrystalline materials [1]. The processing conditions of nanomaterials influence their lattice defect structures, therefore the properties of nanocrystalline materials can be tailored by an appropriate selection of the production methodology. X-ray diffraction line profile analysis is a non-destructive method for the characterization of lattice defect structure in nanomaterials [2]. This technique is very effective in the determination of density, arrangement and type of dislocations as well as probability of planar faults (stacking faults and twin boundaries). In this presentation, the fundamentals and the basic methods of X-ray line profile analysis are overviewed. In addition, illustrative examples are given for the determination of defect structures in ceramic nanomaterials. The correlation between the processing conditions and the lattice defect structure for Si_3N_4 and CeO_2 loose powders, as well as for sintered SiC is revealed.

[1] J. Gubicza: Defect Structure and Properties of Nanomaterials, 2nd and Extended Edition, Woodhead Publishing, an imprint of Elsevier, Cambridge, MA, USA, (2017).

[2] J. Gubicza: X-ray line profile analysis in Materials Science, IGI-Global, Hershey, PA, USA (2014)