Defect structure in advanced nanostructured materials

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Abstract

Nanostructured materials are in the forefront of materials science due to their unique properties (e.g., improved mechanical and magnetic performances). The properties of nanomaterials can be tuned by changing the lattice defect structure, such as the amount, type and arrangement of dislocations, planar faults and grain boundaries [1]. The defect structure can be tailored by an appropriate selection of the processing conditions and post-processing treatment (e.g., anneling). In this presentation, the influence of the manufacturing circumstances and the subsequent thermal treatment on the lattice defects in advanced nanomaterials is overviewed. This effect is investigated on bulk nanocrystalline metals and alloys (such as high entropy alloys) processed by top-down methods (i.e., by severe plastic deformation) as well as thin films, nanoparticles and metallic nanofoams manufactured by bottom-up techniques. Special emphasis is placed on the study of the defect structure by X-ray line profile analysis [2]. The latter method is very effective and non-destructive way of the study of the lattice defects with good statistics. The correlation between the defect structure and the properties of the novel nanostructured materials is revealed and discussed in detail.

[1] J. Gubicza: Defect Structure and Properties of Nanomaterials, 2nd and Extended Edition, Woodhead Publishing, an imprint of Elsevier, Duxford, UK, (2017)
[2] J. Gubicza: X-ray line profile analysis in Materials Science, IGI-Global, Hershey, PA, USA, (2014).