Doctoral School of Information and Biomedical Technologies Polish Academy of Sciences

Subject
Interaction of plastic deformation mechanisms in single crystals at micro and meso-scale.

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Project Description

The plastic deformation is a multi-scale phenomenon in which there is strong correlation between deformation mechanisms observed at the micro-scale, meso-scale, and macro-scale [1,2]. The investigation at micro-scale, at a level of single grains (single crystals) have a fundamental character as it enables an understanding a material behaviour at higher observation scale and to formulate effective constitutive model for polycrystals. In plastic deformation of single crystals one observes specific effects that are scale dependent and not fully understood: work hardening, work softening and size effect. Work hardening manifests as an increase of stress with increase of strain, while size effect take place at fixed strain in a transition from macro to meso- or micro-scale and it manifests as an increase of stress when plastic deformation zone or the sample size decreases [3]. One can expect that The size effect and work hardening (or work softening) are strongly correlated with dislocation motion effect so one can expect that they are coupled [4]. The study of this interaction is a proposed dissertation subject. In frame of investigations the series of experiments will be performed at micro and nanoscale, that is micro-indentation, nano-indentation, compression of micro-pillars and tension of micro-beams. Two kinds of material response in indentation test will be analyzed: load-penetration curves and a topography of residual impression. For selected samples the experiments will be conducted in situ in SEM or under optical microscope. The research will be focused on FCC single crystals (copper, nickel, NiAl3).

Bibliography

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