Submicron structure characterization in hexagonal materials deformed plastically by complex loading.

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In this work high purity polycrystalline zinc and commercial purity (CP) titanium deformed plastically by means of complex loading in the KoBo method have been investigated. KoBo is a technique for plastic forming of materials that introduces high amounts of strain into material by single step of complex loading. KoBo type extrusion is a combination of classic extrusion with twisting by reversible rotation – oscillation of extrusion die.

In this study high purity zinc have been extruded with three different extrusion ratios (cross sectional area reduction): λ493, λ400 and λ100 and CP titanium (grade2 and grade4) have been extruded with λ19 and λ12 respectively.

Microstructure investigation have been performed by high resolution SEM FEG Quanta microscope with integrated EBSD system. Crystal orientation measurements have been performed for all samples. Microstructure and texture quantitative analysis have been carried out. In cases of both types of materials microstructure after deformation is substantially refined and strongly heterogeneous, with grain sizes ranging from tens of microns to single microns size. Strong axial texture is characteristic for all kinds of examined samples with 0001 basal planes aligned parallel to the extrusion direction. Grains are typically elongated in extrusion direction, however grain shape parameter varies between zinc and titanium. Internal subgrain structure is found for both deformed material types, consisting of crystal lattice bending, resulting in slight misorientation variation along grain axis, as well as formation of dislocation walls and low angle grain boundaries. Additional analysis of image quality parameters reveals characteristic structure of crystal lattice deformation concentrated along grain boundaries. Those deformation zones are occupying considerate fraction of material structure and are believed to improve material mechanical properties in addition to typical Hall - Petch strengthening.