Experimental analysis of material, lattice and plastic rotation during deformation of aluminum multicrystal

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The paper focuses on the experimental determination of the distribution of material **R**, lattice $\mathbf{R}^e$ and plastic $\mathbf{R}^p$ rotation during deformation of Al multicrystal. The proposed methodology uses standard electron backscattering diffraction technique combined with 3D digital image correlation data [1]. The areas were identified where the material rotation angle was close to zero and the lattice rotation angle was approximately equal to 15°. In this case the plastic rotation angle is equal to the lattice rotation angle, but they operate in opposite directions and it seems to be possible only when some volume of material deformed by one dominant slip system is 'rigidly' rotated due to internal constrains (Fig. 1). A relatively uniform distribution of lattice rotation observed in this region indicates low increase in GNDs' density in this area. On the other hand, the small areas where $\mathbf{R}^e = \mathbf{I}$ and $\mathbf{R} \neq \mathbf{I}$ corresponds to the regions where deformation proceeds by one dominant slip system with almost no constrains.

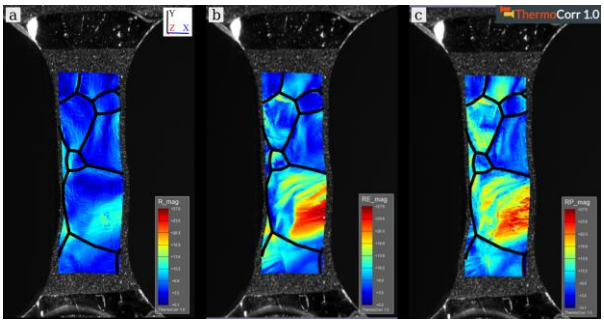

Fig.1 The distributions of the absolute value of the angle of a) material rotation **R**, b) lattice rotation $\mathbf{R}^e$ and c) plastic rotation $\mathbf{R}^p$ for deformed specimen after unloading.

Keywords: image analysis, plastic deformation, misorientation, plastic rotation.

References:

[1] M. Maj, M. Nowak, S. Musiał, T. Płociński, Experimental analysis of material, lattice and plastic rotation during deformation of aluminium multicrystal, Mat. Sci Eng. A, 790 (2020) 139725.