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IT-9-O-2129 Mapping distortion and strain with EBSD in Cu single crystals

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Cross-correlation based analysis of electron backscatter diffraction (EBSD) patterns is often carried out to map plastic strain variations in deformed polycrystalline samples [1]. In this work this method is applied to characterize the evolution of dislocation structures and corresponding distortion fields in Cu single crystals compressed to different levels. We aim at developing a statistical method that can be used to measure the total dislocation density in the specimen.

Firstly, the effects of sample surface preparation methods were investigated including Ar ion polishing and traditional electropolishing treatments. Then the distortion maps of the specimen are computed with the cross-correlation technique. This method is capable of detecting changes of the crystal orientation to higher accuracy than the commercial software provided for standard EBSD devices that analyse each EBSD pattern individually. The distribution of distortions shows broadening with increasing load and a slow decay. To give a more detailed evaluation of the microstructure the measurements are complemented with the analysis of broadened X-ray diffraction (XRD) peaks. The total dislocation density and its fluctuation within the sample are determined by the variance method [2,3]. The good qualitative agreement found between the two methods indicate that the cross-correlation method is capable of giving a statistical characterization of the dislocation structure.

In the last part of the talk EBSD measurements on thin foils are presented where the cellular dislocation structure can be directly observed by transmission electron microscopy. These results demonstrate the advantage of the EBSD method compared to XRD analysis, namely that the former is not only capable of determining the dislocation density but also yields the spatial distribution of dislocations.

References:

[1] T.B. Britton and A.J. Wilkinson, *High resolution electron backscatter diffraction measurements of elastic strain variations in the presence of larger lattice rotations.* Ultramicroscopy 114 (2012) 82-95.

[2] I. Groma, *X-ray line broadening due to an inhomogeneous dislocation distribution.* Phys.Rev.B 57 (1998) 7535-7542.

[3] F. Székely, I. Groma and J. Lendvai, *Changes in the dislocation density fluctuations during plastic deformation.* Scripta Mat. 45 (2001) 55-60.

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