Utilization of Electron Channelling Contrast Imaging to Display Crystal Lattice Orientation in Scanning Electron Microscope

Cupera, J.[1] and Jan, V.[1]

[1] Institute of Materials Science and Engineering, Brno University of Technology, Czech Republic

Scanning electron microscopy is a versatile tool to allow analyze amorphous and crystalline substances with the aid of a charge current particles with great kinetic energy. interaction of energy electrons with the atoms contained in the material under investigation causes a cascade of processes, which results in the emission of various signals that are detected by the detectors located in the microscope chamber. One type of signal electrons is named as backscattered electrons (BSE) which brings classical compositional contrast information or crystallography information via Electron Backscattered Diffraction (EBSD). It turned out that the BSE signal is weakly modulated [1]. Modulation is dependent on grid orientation and distortion. This is used, for example, to display elastic strains and plastic deformations conventionally viewable by EBSD [2,3].

The method using BSE modulation is called Electron Channelling Contrast Imaging - ECCI. The use of this method to distinguish individual grains according to the orientation of the grid is fully represented by the EBSD method, which is accurate but requires the inclination of the sample to large angles, and the acquisition of the signal from the entire area being investigated is time consuming. Detecting of modulated BSE signal on a horizontally placed sample shows that each grain has a different shade of gray, which varies with the tilt of the sample - shade change occurs even at very small tilt. If shade changes are measured within a certain range of tilts and this is plotted, it can be seen that the differently oriented grains show significantly varying degrees of grain intensity (intensity signal) on the tilt of the sample.

If the measured curves will be compared with the grain orientation, orientation of grains could be determined by image analysis from an images taken with BSE detector at a small range of tilts. Thus, a time saving for grain orientation analysis can be obtained compared to the EBSD method. As well as the ability to analysis of larger samples is provided - dimensions of sample are significantly limited in EBSD method by the geometry of this EBSD.

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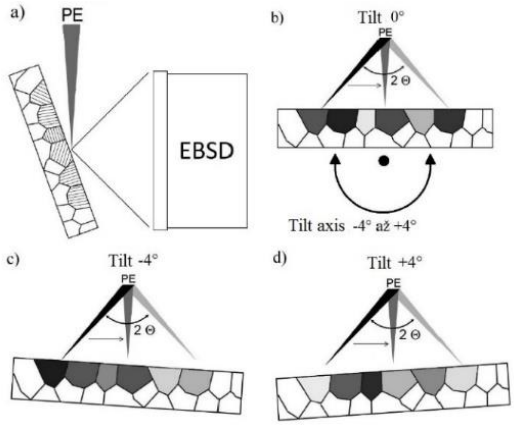
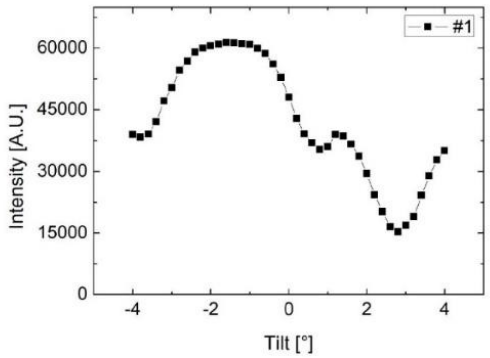
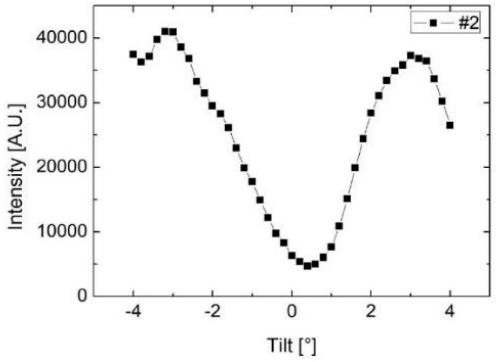


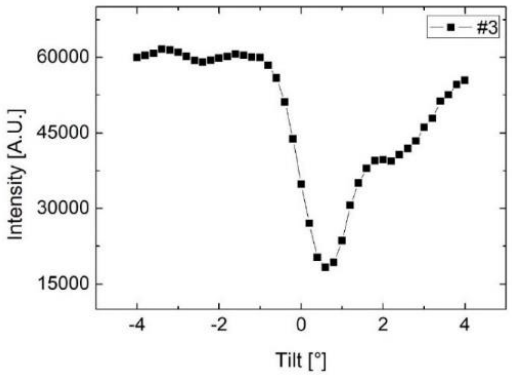
Img. 1: Schematic representation of the ECCI procedure. a) correlation: orientation identification via EBSD, b), c), d) BSE intensity (mean gray value) measurement at various tilts



Img. 2: Dependence of BSE intensity on sample tilt. Lattice orientation (100) relative to the surface



Img. 3: Dependence of BSE intensity on sample tilt. Lattice orientation (101) relative to the surface



Img. 4: Dependence of BSE intensity on sample tilt. Lattice orientation (111) relative to the surface