

Phase Identification, Strain Analysis and Data Subset Analysis using Electron Backscatter Diffraction (EBSD)

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EBSD is an SEM-based electron diffraction technique that is rapidly gaining popularity in the materials characterization community as a general characterization tool. Diffraction patterns are generated by placing the electron beam on a polished, highly tilted sample surface, and then captured with a phosphor screen-based detector placed close to the beam/specimen interaction point. Images of the captured patterns are then analyzed by the EBSD software for phase identity and crystallographic orientation. The volume of sample under the beam that is effectively analyzed is dependant on a variety of factors, especially probe diameter, but grains on the order of 30 to 500nm may be individually analyzed. In phase identification mode, a diffraction pattern is collected from a point on the sample and indexed against a group of potential match phases, selected either using chemical information obtained simultaneously by the EDS system for phase database searching, or by direct user-selection. In mapping mode, patterns from a designed grid of points are automatically collected and indexed, the process taking 1 to 0.01 seconds per point, depending on sample and conditions. The resulting data is used to generate a large variety of EBSD maps, as well as pole figures and ODFs. Quantitative analyses include grain size, grain shape, boundary characterization, phase area % and distribution, and texture. Analysis of plastic strain is accomplished by examining intra-granular variations in orientation, as well as by relative diffraction pattern quality reduction due to lattice defects. Although difficult to quantify, qualitative analysis of plastic strain is robust, and can be performed at submicron-scale resolutions. Sampling in EBSD is available in post processing, where sub-populations of grains or pixels (subsets) can be comparatively analyzed. Populations may be selected by defining areas on the EBSD map or pole figures, or by defining ranges of grain size, grain shape, texture definition compliance or by any other differentiating characteristic available in EBSD.