Distortion correction for EBSD maps and quantitative analysis for ex-situ EBSD experiments

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Drift during electron backscatter diffraction (EBSD) mapping leads to coordinate distortions in resulting orientation maps. The drift affects, in some cases significantly, the accuracy of analysis. To correct such coordinate distortions in the maps after the EBSD measurements, a thin plate spline method using secondary or backscattered imaging as references is introduced and tested [1]. After correction, errors less than 1–2 pixels are typically obtained.

Application of this method is demonstrated with an ex-situ annealing experiment [2]. The material studied is pure copper cold-rolled to a thickness reduction of 90%. The sample was annealed repeatedly at 150 °C for different time intervals, and the same region was characterized using EBSD before and after each annealing step. Distortions between different EBSD maps were corrected, and maps after correction were used for quantitative analysis. By comparing individual recrystallized grains, it is found that different segments of the recrystallizing boundaries migrate with significantly different velocities. Some boundaries, although unimpinged, remain stationary. This non-uniform migration of recrystallizing boundaries leads to an amoeba-like growth, and is proposed to be responsible for the decrease of the average boundary migration velocity, because the fraction of slowly moving/stationary boundaries increases during the recrystallization. Reasons for stationary boundaries are discussed based on a quantitative analysis of the local deformed microstructure. It is shown that the non-uniform boundary migration behavior is related to the misorientations with the deformed matrix, whereas effects of stored energy are less significant. It is further suggested that the local geometrical arrangement of the dislocation boundaries affects boundary migration.

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