Three-dimensional Interfacial Grain Boundary Network Characterisation in Polycrystalline Materials

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Grain boundary is known as one of the key microstructural features, which controls certain properties of polycrystalline materials. The nature and crystallography of the grain boundary is a critical parameter governing the material performance. The key issue is to control the population and connectivity of certain grain boundary type/s (i.e., the grain boundary network) that are relevant to the property of interest to obtain the required material performance. This work comprehensively characterised the three-dimensional interfacial grain boundary network in different polycrystalline materials as a function of all five macroscopic crystallographic parameters (i.e., lattice misorientation and grain boundary plane normal) using electron backscattering diffraction mapping in conjunction with focused ion beam serial sectioning. The ultimate aim was to investigate the role of different parameters, namely crystal structure, processing route, texture and phase transformation mechanism, on the characteristics of grain boundary network in polycrystalline materials. This study revealed that the processing route and overall texture of polycrystalline material significantly alter the population of a given boundary, though they do not affect the grain boundary plane orientation. By contrast, the crystal structure and phase transformation mechanism change both the population and grain boundary plane orientation.

Keywords: grain boundary network, crystal structure, texture, phase transformation, processing route