DOCTOR OF PHILOSOPHY
IN
MECHANICAL ENGINEERING

DEFORMATION BANDING AND GRAIN REFINEMENT IN FCC MATERIALS

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Microscopy methods in scanning and transmission electron microscopes have been employed to assess microstructures developed by deformation processing of selected face centered cubic (FCC) materials. Grain maps constructed from orientation data and analysis of transmission data illustrate the presence of fine grains and deformation bands in which the lattice orientation contains symmetric variants of a texture component. A banded, deformation microstructure is present to various degrees in FCC material systems irrespective of processing and material composition. The specific components of the deformation bands were observed to vary depending upon processing conditions of the material and the specific material. Single component and entire deformation textures from shear and plane strain, were both observed. The high-angle (40˚-62.8˚) interfaces or boundaries in the microstructure evolve from the interfaces between the bands while the lower-angle (2˚-15˚) boundaries tend to separate cells within the bands. Models of microstructural development that include deformation banding during cold working may be employed to describe both texture development and the origin of the high-angle grain boundaries.

KEYWORDS: Grain Refinement, Ultra-fine Grains, Deformation Banding, Plastic Deformation, Severe Plastic Deformation, Misorientation Angle, Orientation Imaging Microscopy, Electron Backscatter Diffraction, Equal-Channel Angular Pressing, Supral 2004, Nano Structures, Transmission Electron Microscopy