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Grain Refinement and Mechanical Properties of Three 5xxx Aluminum Alloys after Equal Channel Angular Extrusion

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The Equal Channel Angular Extrusion (ECAE) is formed from two channels of equal cross-section, intersecting to form a 'sharp' corner. Deformation occurs at the die corner as the billet is pressed. Effective strain per pass is dependent on the angle of intersection of the die channels and to a lesser extent on the fillet radius at the die corner. ECAE has been used for uniform plastic deformation [1], increase material strength, and produce ultrafine-equiaxed grains (UFG) [2], complex microstructures [3] and powder consolidation or compaction [4].

This present work looks at the changes in the properties of three 5xxx aluminum alloys of similar compositions after ECAE at room temperature for 4 passes. The compositions of the three aluminum alloys are: 5083 H116 Al 94.04, Cr 0.113, Cu 0.047, Fe 0.278, Mg 4.465, Mn 0.65; 5086 H116 Al 94.80, Cr 0.124, Cu 0.038, Fe 0.227, Mg 4.137, Mn 0.437 and 5456 H116 Al 93.96, Cr 0.11, Cu 0.10, Fe 0.17, Mg 4.85, Mn 0.65.

Microstructural properties that have been looked at include grain size, misorientation angle variation and the textural homogeneity/heterogeneity across the three materials. Microhardness and hardness are some of the mechanical properties measured for all the test samples. Equipment used for these measurements include ESEM, OIM, x-ray diffractometer and optical microscope.

Some of the results of this work are still being collated. Figures 1 to 3 represent the inverse pole figures of the surfaces of the as-received materials as determined by an x-ray diffractometer. It could be seen that there is some degree of textural homogeneity across the as-received materials.

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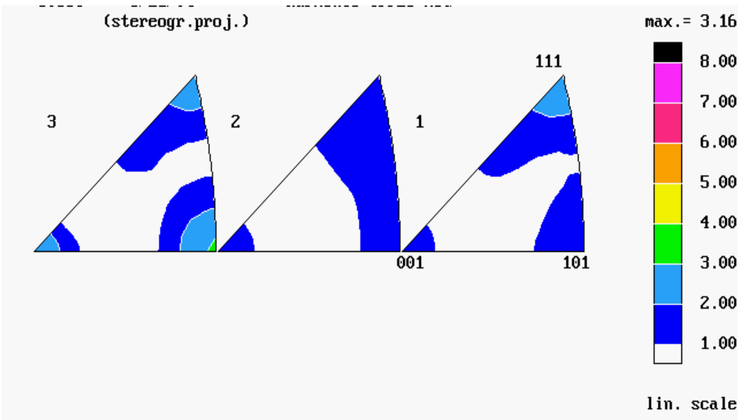

Figure 1. Inverse Pole Figure of the surface of as-received 5083

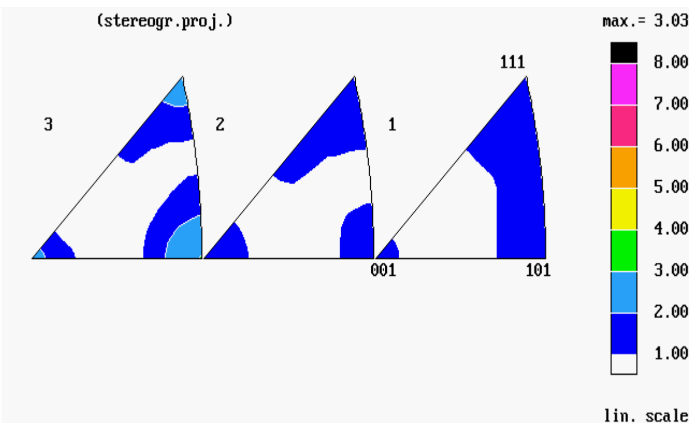

Figure 2. Inverse Pole Figure of the surface of as-received 5086

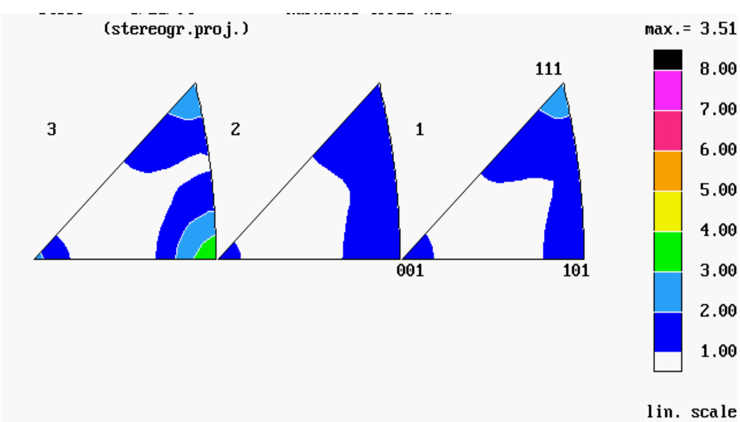

Figure 3. Inverse Pole Figure of the surface of as-received 5456

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