High Pressure Compressive Reciprocating Shear of pure magnesium

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Abstract

Magnesium being the lightest structural material, is an attractive choice in weight critical applications. However, it exhibits poor ductility and formability at room temperature. At this temperature, only basal slip and twinning mechanisms can be activated to accommodate the deformation. But magnesium with basal texture shows anisotropic behavior. Specifically, it exhibits good ductility in the loading conditions where deformation can be accommodated through basal slip. Taking advantage of this behavior, the deformation of basal textured magnesium was done through a newly developed Severe Plastic Deformation process – High Pressure Compressive Reciprocating Shear (HPCRS). During this process shear deformation was imposed, and predominantly basal slip was activated. The results are confirmed through microstructure and bulk texture study. Microstructural investigations were carried out by SEM-EBSD and bulk texture was measured by X-ray diffraction technique. Consequently, large strains could be imposed through this process without fracturing the sample. As a result, the grains with average size of 50 μm were refined to average grain size of 6 μm in a single step. A strong B-fiber shear texture was developed after the shear deformation. The simulations for texture evolution were performed using viscoplastic self-consistent approach. Texture simulations were in good agreement with the experimentally measured texture. Moreover, simultaneous increase in the strength and ductility was achieved because of the developed texture and grain refinement.

Keywords: SPD, Magnesium, Shear Texture

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