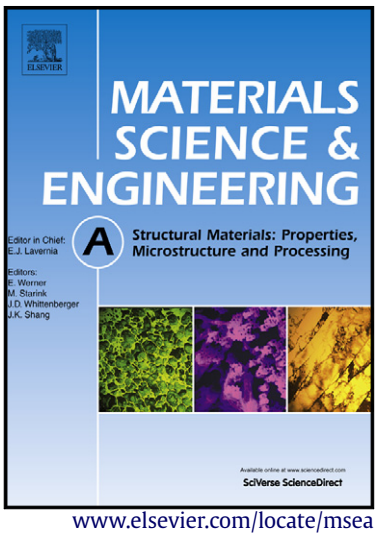

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Grain refinement in a Cu-Cr-Zr alloy during multidirectional forging

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Abstract

The structural changes during plastic deformation were studied in a Cu-0.3%Cr-0.5%Zr alloy subjected to multidirectional forging up to a total strain of 4 at the temperatures of 300 K and 673 K. The deformation behavior was characterized by a rapid increase in the flow stress at an early deformation followed by a steady–state flow at large strain. The development of the new ultrafine grains resulted from the progressive increase in the misorientations of the strain-induced low-angle boundaries, which evolve into high-angle boundaries with increasing cumulative strain through a strain-induced continuous reaction that is quite similar to continuous dynamic recrystallization. The formation of ultrafine grains was closely related to the development of geometrically necessary boundaries that is attributed to deformation banding. The grain refinement kinetics increased with an increase in the deformation temperature. At 673 K, the area fractions of the ultrafine grains with a size below 2 μm were 0.36 and 0.6 in the initially solution treated samples and the aged samples, respectively. However, the area fractions of the ultrafine grains did not exceed 0.2 at 300 K.

Keywords: Cu-Cr-Zr Alloy; Large Strain Deformation; Grain Refinement; Precipitation; EBSD.

1. Introduction