Improving Strength Ductility Trade-off by Gradient Microstructure in OFHC pure Copper

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In the present investigation, the strength ductility trade-off was improved by manufacturing gradient microstructure (GM) of oxygen-free high conductivity pure copper. In order to do that, trapezoidal groove geometries with 2 mm minimum thickness at the center in an 8 mm thick plate were machined. Further, the sample was rolled upto 1.6 von Mises strain at an increment step of 0.12 at room temperature that leads to a strain gradient microstructure and a transition from copper type texture to brass type texture along the transverse direction (TD). The rolled samples were subjected to annealing at 573 K for various times, i.e. 10, 20, 30, and 60 minutes. The microstructural characterization suggested a variation in the grain size having coarse grain in center and fine at the end due to different rates of recovery and recrystallization in the strain gradient microstructure. The microtexture analysis of annealed samples suggested a combination of deformation and recovery & recrystallization texture depending on the prior stored energy and annealing time. The microhardness test was carried out, and increment was calculated from the center to the end along TD due to Hall-Petch strengthening. Moreover, the tensile test of selected annealed samples for 10 and 20 minutes suggested a better combination of strength and ductility with improved work hardening compared to their homogeneous microstructure counterparts. Enhanced work hardening is attributed to additional storage of the geometrical necessary dislocations which were developed due to the strain partitioning between soft region (coarse grains) and hard region (fine grains) during plastic deformation.

Keywords: *Gradient microstructure, Rolling, OFHC Copper, Texture transition, Strength ductility trade-off*