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Room Temperature Bonding of Copper and Aluminum in High-Pressure Tube Twisting

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The High-pressure tube torsion (HPTT) process was proposed in 2009 by Toth et al. [1] (modified in 2012 [2]) in which grain refinement and high strength can be achieved in bulk metal materials with tubular geometry. In this study, this process was applied for achieving metal-metal bonding between Al-Al, Cu-Cu and Cu-Al at room temperature. The initial samples were constructed by four tube-quadrants in a 4 x 90° configuration. Perfect bonding was achieved in all cases. For the Cu-Al case an architecturing of the tube was achieved; the Cu and Al layers appeared in form of five helicoids, in agreement with simulation. The good bonding characteristics were obtained thanks to the extreme increase of the initial contact surfaces between the tubes which were increased by 47 times in one revolution. Characteristic simple shear textures developed in both phases. Due to the large strain, the Al phase reached the steady state of grain fragmentation in one revolution, nonetheless the Cu phase deformed less, which was evidenced by the next-neighbor disorientation distributions obtained from EBSD investigation.

Keywords: Severe Plastic Deformation, High-Pressure Tube Twisting, Architectured Materials, Metal Bonding.

Fig.1 The final samples after one-turn HPTT process a) Pure aluminum, b) Pure copper, and c) Architectured tube produced by HPTT.

References:

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