

Influence of the Process Parameters on Physical Properties of CuMCs

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Abstract

Copper matrix composites (CuMCs) are advanced materials that combine the superior electrical and thermal conductivity of copper with the enhanced strength, hardness, and wear resistance of the reinforcing phases. Due to this unique combination of properties, CuMCs are widely used in electrical contacts, heat sinks, braking systems, and aerospace components. The samples manufactured in this study were obtained after 30h of mechanical alloying, at a 10:1 ball-to-powder ratio. After the powders were mechanically alloyed, they were subjected to three different powders' consolidation techniques: (i.) cold pressing followed by sintering, (ii.) hot pressing and (iii.) spark plasma sintering (SPS). Obtained results of dislocation densities (DD) revealed that highest DD values are recorded at SPS samples, then for hot-pressed samples and lowest at sintered samples for both pure copper and Cu based composites. These findings are in agreement with determined macro hardness results. The lowest values of electrical and thermal conductivities are recorded after sintering at both pure copper and CuMCs samples. On the other hand, values of electrical and thermal conductivities of pure copper show the highest values after hot pressing while highest values of observed CuMCs are reached after SPS. Furthermore, values of electrical and thermal conductivities of pure copper show the highest values after hot pressing while highest values of observed CuMCs are reached after SPS. Deviation that the hot-pressed pure copper sample exhibits slightly better conductivity compared to the sample after SPS could be a consequence of lower electron scattering at grain boundaries and lower porosity.

Keywords: Cu matrix composites; dislocation density; electrical conductivity; thermal conductivity

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