Consolidation Behavior of W-15wt.%Cu Nanocomposite Powder Prepared by Mechanochemical Process Using W-CuO Mixture

Hanyang University, Kwang Hyun Park*, Dae-Gun Kim,
Young Do Kim
Seoul National University of Technology, Sung-Tag Oh

Tungsten-copper (W-Cu) composties are used for thermal and electrical managing applications due to high thermal conductivity of Cu and low coefficient of thermal expansion of W, for example, ultrahigh-voltage electric contact materials, microelectronic applications like blocking materials for microwave packages and heat-sink materials for high density integrated circuit. In general, W-Cu composites have difficulties to achieve full densification by liquid phase sintering because of the mutual insolubility and high contact angle. Thus, the development of full-densification processing is necessary for applications of W-Cu composites as electrical and thermal managing materials. Recently, the mechanochemical process (MCP) using a mixture of W- and Cu-oxide has been applied to fabricate the W-Cu nanocomposite powders. These powders, with homogeneous distribution of fine W and Cu particles, have excellent sinterability by enhanced W particle rearrangement during liquid phase sintering. Also, the sintered composite shows homogeneous microstructure with fine W grains. However, there are some difficulties using W-oxide in mass production due to the complexity of the hydrogen-reduction process. In this regard, it has been suggested that W-Cu nanocomposite powders could be mass produced by a new type of processing, in which the elemental W and CuO were used as starting powders.

Based on previous study, in the present investigation, nanocomposites which have homogeneously distributed 40nm W particles by mixing W and Cu-oxide and subsequent reduction on low temperature at 300°C were produced. The nonocompostes showed good densification and solid phase sintering behavior above 600°C clearly. The solid state sintering behavior, which was effected by Cu exuding during heating up, depended on heating rate dominantly. Also, it is thought that homogeneity of the last sintering microstructure was influenced by heating rate.