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Growth Behavior of W Particle during Liquid Phase Sintering of Nanocomposite W-Cu Compact

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The growth behavior of W particle during liquid phase sintering was investigated. Generally the W particle begin to grow at the melting point of Cu in W-Cu system. However, the early growth of W particle is found in nanocomposite W-Cu system below Cu melting point. Such a phenomenon is caused by the nonequilibrium state of nanocomposite powder prepared by mechanical alloying(MA). MA is an easy method of synthesizing nanostructured materials in large quantities. But it must be considered that residual strains of powders and impurities as a small amount of Fe could affect the mechanism of particle growth. In this study the initial W particle size during liquid phase sintering of nanocomposite W-Cu compact below the Cu melting point was investigated, and the growth behavior of W particle was analyzed in consideration of residual strains and impurities caused by mechanical alloying process as important factor to affect the particle growth mechanism.

In order to prepare W-30wt%Cu nanocomposite powder, MA process was carried out in an attrition mill using stainless steel container and balls with a speed of 400 rpm for 50 hours. And the same condition of nanocomposite powder was prepared by attrition mill using ceramic container and balls to avoid Fe contamination during milling. Milled powders were annealed to remove residual strains. Such annealing process is carried out at 600℃ for 1hours. The microstructure of as-milled powders and annealed powders was analyzed by using XRD. Thermal property was studied by DSC and impurities of powder was analyzed by ICP-AES. Cold compacted specimens were sintered in a hydrogen atmosphere at 1100~1200℃ for 0,1,5,10,15 hour. The sintering behavior of specimens was characterized by measuring the density as well as observing the W grain size by SEM.

The grain growth parameter, such as growth exponent value n, and the activation energy for particle growth were determined from the W grain size analysis data. The grain growth behavior and kinetics in the nonequilibrium state of the immiscible W-Cu alloy system were discussed.