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Grain growth of Cu-dispersed Al_2O_3 by isothermal heat treatment

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1.Introduction

In recent years, a great deal of attention had been paid to ceramic-based metal composite due to their specific properties, such as high strength and hardness, low density and excellent resistance to severe thermal and chemical environments by their fine grains[(1)]. Nevertheless, these specific properties were diminished by the thermal instability of grains. Therefore, an understanding on the grain stability in nanocomposite materials was important. In the past, some investigation on grain growth kinetics for ceramic had already been reported[(2)].

In the present study, grain growth behavior and restraint of Al_2O_3/Cu nanocrytalline were investigated by means of isothermal heat treatment.

2. Experimental Methods

Starting mixtures were prepared from the following powders ; α-Al_2O_3 (99.99 %, 0.1-0.2 ㎛) and CuO powder (99.9%, 1-2㎛). α-Al_2O_3 and CuO powders were mixed with final composition of 1~5vol.%Cu in the composites. The powder mixture was high energy ball milled at the rotating speed of 900 rpm for 5h. The milled powders were heat treated for 30 min at 300℃ in H_2 atmosphere to reduce CuO into Cu. The composite powders were sintered at 1250℃ for 5 min in vacuum under a pressure of 50 MPa by using PECS.

Al_2O_3/Cu nanocomposite was heated by isothermal method in the air atmosphere as a function of temperature (900~1250℃) and time (1~1000min). The grain growth of Al_2O_3 in the Al_2O_3/Cu nanocomposites were measured by SEM and linear intercept method. Micrographs for linear intercept method(more than 200 grains) were taken in randomly selected area of each specimen. And activation energy was calculated using this data.

3. Result and Discussioin

Al_2O_3/Cu nanocomposite was fabricated by reduction and PECS of an Al_2O_3/CuO powder mixture. Relative densities of sintered parts were over 99%. Grain growth of Al_2O_3 in Cu dispersed Al_2O_3/Cu nanocomposite was restrained below 1050℃.

At above 1100℃, grain growth of Al_2O_3 in Al_2O_3/Cu nanocomposite was dramatically occurred. It was considered that Cu melted during heat treatment above 1083℃ was insufficient to inhibit grain growth of Al_2O_3 in Cu dispersed Al_2O_3/Cu.

4. Reference

1. T.Sekino, T.Nakajima, S.Ueda and K.Niihara, J. Am. Ceram. Soc., **80** (1997) 1139.
2. Y.Zhou, K.Hirao, Y.Yamauchi and S.Kanzaki, Scripta Mater. **48** (2003) 1631.