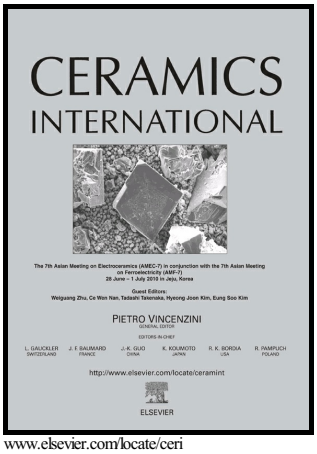

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Jin-Myung Kim, Sin-Il Ko, Ha-Neul Kim, Jae-Woong Ko, Jae-Wook Lee, Hai-Doo Kim and Young-Jo Park*

Engineering Ceramics Research Group, Korea Institute of Materials Science, 797 Changwondaero, Changwon, Gyeongnam, 641-831, Korea

*Author to whom correspondence should be addressed. Phone: 82-55-280-3356; Fax: 82-55-280-3392. yjpark87@kims.re.kr

Abstract

In this study, the binary sintering additives Y_2O_3-Sc_2O_3, were first applied to the Si_3N_4 system to investigate their effects on microstructure and thermal conductivity. The microstructure and thermal conductivity of both sintered silicon nitride (SSN) and sintered reaction-bonded silicon nitride (SRBSN) were found to be significantly dependent on the additive composition. Among various combinations of Y_2O_3 and Sc_2O_3, 1mol% Y_2O_3-3mol% Sc_2O_3 prominently enhanced thermal conductivity, and the enhancement could not be attributed to any difference in microstructure or lattice defects. TEM observation revealed that this composition was more liable to devitrify the glassy phase with a lower degree of stress accumulation, and to possibly produce a grain boundary that was cleaner or with a higher order of atomic arrangement. A microstructure model for thermal conductivity was proposed which took the thermal resistance of the grain boundaries into account. The grain boundary state exerted a remarkable influence on the thermal conductivity of fine microstructures, and the experimentally measured thermal conductivity values were consistent with those given by the proposed model.