World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:11, No:07, 2017

Effect of Nano/Micro Alumina Matrix on Alumina-Cubic Boron Nitride Composites Consolidated by Spark Plasma Sintering

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Abstract : Alumina (Al2O3) - cubic boron nitride (cBN) ceramic composites were sintered by spark plasma sintering (SPS) using α-Al2O3 particle sizes; 150 µm, 150 nm and cBN particle size of 42 µm. Alumina-cBN composites containing 10, 20 and 30wt% cBN with and without Ni coated were sintering at an elevated temperature of 1400°C at a constant uniaxial pressure of 50 MPa. The effect of matrix particle size, cBN and Ni content on mechanical properties and thermal properties, i.e., thermal conductivity, diffusivity, expansion, densification, phase transformation, microstructure, hardness and toughness of the Al2O3-cBN/(Ni) composites under specific sintering conditions were investigated. The highest relative densification of 150 nm-Al2O3 containing 30wt% cBN (Ni coated) composite was 99% at TSPS = 1400°C. In case of 150 µm- Al2O3 compositions, the phase transformation of cBN to hBN were observed, and the relative densification decreased. Thermal conductivity depicts maximum value in case of 150 nm- Al2O3-30wt% cBN-Ni composition. The Vickers hardness of this composition at TSPS = 1400°C also showed the highest value of 29 GPa.

Keywords : alumina composite, cubic boron nitride, mechanical properties, phase transformation, Spark plasma sintering
Conference Title : ICCFM 2017 : International Conference on Ceramic and Functional Materials
Conference Location : Istanbul, Türkiye
Conference Dates : July 27-28, 2017