MULLITE TEMPLATING EFFECT AND PARTICLE SIZE INFLUENCE ON THERMO-MECHANICAL PROPERTIES OF CORDIERITE-MULLITE CERAMIC STRUCTURES

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Abstract

In this study, we present findings on mullite templating effect on microstructure and how the particle sizes of SiC and Al_2O_3 influence the thermomechanical properties of cordierite-mullite ceramic structure. Initial SiC and Al_2O_3 were milled at 600rpm for 2 hours to synthesize submicron particles. Three sample sets consisting of CHS96, initial particle size and 600rpm 2hr-milled particles were synthesized. Kaolin, clay, Al_2O_3, talc, mullite, chamotte and SiC were mixed in appropriate ratios for two hours and aged for 24 hours. Liquidity levels were adjusted within the range of 180-250, and the thixotropy set between 30-70. The green samples were moulded for one hour, dried between 30-50^{O}C for 48 hours, and then fired at 1350^{O}C for 3½ hours. The Field Emission Scanning Electron Microscope (FESEM) results showed the formation of acicular mullite with interspersed cordierite in the mullite phase. X-ray Diffraction (XRD) analysis of the fired samples confirmed the presence of distinct peaks corresponding to cordierite, mullite, SiC and Al_2O_3 phases at 2θ angles of 29.7^{O}, 31.2^{O}, 35.7^{O} and 43.8^{O}, respectively. The coefficient of thermal expansion (CTE) in SiC samples reduced from 3.75 x 10^{-6}/ k to 3.50 x 10^{-6}/ k. This was attributed to enhanced thermal conductivity, which rose from 1.322 to 1.792 W/ mk in the SiC specimens. The thermal conductivity in Al_2O_3 samples was found to be lower compared to SiC samples. The CTE and Thermal conductivity were found to be independent of SiC particle size. Al_2O_3 particles enhanced flexural strength of the samples while SiC particles lowered the bending strength. Al_2O_3 particles that were milled at 600rpm for 2 hours resulted in a bending strength of approximately ≈40 MPa, while SiC particles, under similar conditions, yielded a bending strength of ≈34.8 MPa.

Keywords: Templating Effect, Particle Size, Bending Strength, Thermal Conductivity, X-Ray Diffraction, FESEM