Crystal structure of single phase and low sintering temperature of α-cordierite synthesized from talc and kaolin

Abstract

Cordierite body with the formulation of $2.8MgO{\cdot}1.5Al_2O_3{\cdot}5SiO_2$ was prepared from talc and kaolin as the basic raw materials. Following glass crystallization technique the glass powder was successfully heat treated at 900 °C for 2 h to form a single-phase α-cordierite. The crystal structure of α-cordierite was analysed using X-ray diffraction technique and the Rietveld structural refinement method. Differential thermal analysis (DTA), Fourier-transform infrared (FTIR), field emission scanning electron microscopy (FESEM), coefficient of thermal expansion (CTE) and dielectric properties were also performed. Results show that the materials crystallized as a hexagonal structure with space group of P6/mcc and the room temperature lattice parameters are a = 9.743742 (Å) and c = 9.389365 (Å). FTIR analysis on the glass revealed that only silicate species is the only unit that exists in the glass network. DTA also confirmed that α-cordierite completely formed after 13.5 min of isothermal heating at 900 °C. Coefficient of thermal expansion of synthesized α-cordierite is 2.5×10^{-6} °C^{-1}. The dielectric constant is between 5.0 and 5.5 for 1 MHz and 1.8 GHz, respectively, and the dielectric loss is in the range 10^{-2}. FESEM micrographs revealed that the material is fully densified.