MceCa12-004

Evaluation of the thermophysical properties of seashell waste-derived calcium niobate ceramic

Alves, A.E.(1); Cordeiro, T.C.(1); Bernardo, P.L.(1); Faria Jr, R.T.(1); Holanda, J.N.F.(1);
(1) UENF;

Seashell waste is produced annually in huge amount worldwide, which requires an environmentally friendly disposal approach. Recently, synthesis of calcium niobate dielectric ceramic utilizing waste materials as sources of calcium carbonate has been developed. However, there is a lack of studies concerning their thermalphysical properties, especially in multiphase calcium niobate. To address this issue, this work evaluated the thermalphysical properties of seashell waste-derived calcium niobate ceramic synthesized at five distinct temperatures. The starting calcium niobate formulation consisted of a mixture in a ratio of seashell waste (CaCO3):niobium pentoxide (Nb2O5) (4:1). Then, the calcium niobate ceramic was synthesized via solid-state reaction method between 800 °C and 1100 °C for 8 h. Structural and morphological analyzes were conducted using XRD and SEM, respectively. Cylindrical specimens of calcium niobate were prepared. Open photoacoustic cell (CFA) and laser flash techniques were used to measure the thermal diffusivity and specific heat capacity of the seashell waste-derived calcium niobate specimens. From the experimental outcomes, thermal conductivity and thermal effusivity were determined. Structural analysis revealed that the synthesis temperature strongly influenced the formation of the calcium niobate ceramic. As the temperature increased, the phases rich in calcium became more prominent, leading to a biphasic calcium niobate ceramic, consisting of Ca2Nb2O7 and Ca4Nb2O9, at 1200 ºC. The thermal diffusivity ranged from 1.86 to 3.12 x 107 m2/s. The specific heat capacity varied between 0.79 and 1.30 x 104 J/Km3. The thermal conductivity ranged from 0.15 to 0.41 W/mK. The thermal effusivity varied between 0.36 and 0.73 kW?s/m2K. It was also found that the thermal properties exhibited a decreasing trend as the synthesis temperature increased to approximately 1000 ºC, followed by stabilization. Therefore, seashell waste-derived calcium niobate ceramics have potential for applications requiring a balance between thermal storage, insulation, and rapid heat dissipation.