

Dielectric properties of Zr doped $\text{CaCu}_3\text{Ti}_4\text{O}_{12}$ synthesized by sol-gel route

ABSTRACT

Zr substituted $\text{CaCu}_3\text{Ti}_4-x\text{Zr}_x\text{O}_{12}$ (CCTZO) with $x = 0.00, 0.02, 0.10, 0.20$ and 0.50 mol% were prepared by sol-gel route from the metal nitrate solutions, Titanium isopropoxide, and zirconium oxy chloride. XRD analysis confirmed the formation of a single phase material in the samples calcinated at 800°C for 3 h. The crystal structure did not change on doping with zirconium and it remained cubic in all the four studied compositions. The permittivity and dielectric loss of 0.1 mol% Zr doped $\text{CaCu}_3\text{Ti}_4\text{O}_{12}$ were improved for $K' \approx 6020$ and $\tan \delta \approx 0.52$ at 1 kHz after the sample had been sintered at 1040°C for 4 h. AFM studies showed that the particle size of the CCTZO powder ranged from 47 to 85 nm. FE-SEM micrographs of the $\text{CaCu}_3\text{Ti}_4-x\text{Zr}_x\text{O}_{12}$ samples showed that the grain size was in the range of 250 nm to 5 μm for these samples. EDX studies showed the presence of calcium, copper, titanium, oxygen and zirconium. Remarkably, the dielectric constant increased and dielectric loss had lower values compared to the undoped CCTO.

Keyword: Ceramics; Sol-gel; Pseudo-perovskite; Atomic force microscopy; Dielectric properties