Effect of Co3O4 doping and sintering temperature on optical energy band gap properties in Zn-Bi-Ti-O varistor ceramics

ABSTRACT

It is necessary to investigate the electronic states of ceramic based ZnO vasristor and effect of doped impurities at different concentration. Band gap (Eg) of the ceramic (99-x) mol% ZnO+0.5 mol% Bi2O3+0.5 mol% TiO2+ xCo3O4 where x = 0, 0.2, 0.4, 0.6 and 0.8 mol%, were determined using UV-Vis spectrophotometer. The samples were prepared via solid-state route and sintered at the sintering temperature at 1110, 1140 and 1170 °C for 45 and 90 min in open air. At no doping of Co3O4, the values of Eg are 2.991 ± 0.001, 2.989 ± 0.001 eV for 45 and 90 min sintering time; respectively. Eg was decreased to 2.368 ± 0.002 and 2.352 ± 0.001 eV at 0.8 mol% Co3O4 for 45 and 90 min sintering time; respectively. XRD analysis indicates that two main phases existed at all concentrations which are ZnO and secondary phases, Bi12TiO20, Zn2Ti3O8, ZnCo2O4 and Co3Ti3O. Relative density decreases with the addition of Co3O4 compared to that of undoped at all doping level. When Co3O4 is added in the ceramics, relative density increases with the increase of doping level at both 45 and 90 min sintering time. The variation of sintering temperatures and XRD findings of steepness factor are correlated with the UV-Vis spectrophotometer results of based ZnO varistor doped with Co3O4 due to the growth of interface states.

Keyword: Co3O4; Optical band gap energy; Ceramics; Zn-Bi-Ti-O