

Effect of Co₃O₄ doping on nonlinear coefficient in Zn-Bi-Ti-O varistor ceramics

ABSTRACT

In the ZnO based varistor, the improvement of nonlinear coefficient (α) and prevention of evaporation of Bi₂O₃ during heat treatments can be achieved by the addition of MnO₂ or Co₃O₄. In this conjunction, it is proper to see the effect of these additives at different low mol percentage and sintering conditions to nonlinear coefficient improvement of the varistor ceramics. In this paper, the investigation regarding to the variation of Co₃O₄ doping on ZnO-Bi₂O₃-TiO₂ system is discussed. Here, the crystalline phases were identified by an XRD (PANalytical (Philips) XPert Pro PW3040/60) with CuK α radiation and the data were analyzed by using XPert High Score software. The density of varistor ceramics was measured by the geometrical method. The current-voltage characteristics of the varistor ceramics were evaluated. The average grain size (d) was determined by lineal intercept method. The α of ZnO doped with 0.5 mol% of Bi₂O₃, 0.5 mol% of TiO₂ and x mol% of Co₃O₄ was calculated from data analysis of current-voltage characteristics obtained through a Source Measure Unit (Keithley 236). The calculation of α is done by using Origin Pro8.0 software. The value of α at low concentration at 1170 °C has the value 5.36 and 3 at 45 and 90 min sintering time, respectively, and then decreases to 4.99 and 2.98 at 0.8 mol% Co₃O₄ concentrations. When the amount of dopant is increased then the value of α increase up to 0.4 mol% and then the value are slightly dropped after further addition. The addition of Co₃O₄ dopant in Zn-Bi-Ti oxide ceramics sintered at 45 minutes cause the value of α to increase up to 0.4 mol% and decrease after further addition.

Keyword: Ceramic; Cobalt oxide; Non-linear coefficient; Zinc oxide varistor