The effect of sintering time on the microstructural and nonlinear electrical properties of ZnV-Mn-Nb-Gd-O low-voltage varistor ceramics

ABSTRACT

There is lacking of study on the prolonged sintering time effect on the microstructural and nonlinear electrical properties of ZnO-V2O5-MnO2-Nb2O5-Gd2O3-based low-voltage varistor ceramics sintered at 900 °C. The aim of this study is to investigate the effect of sintering time from 120 to 210 mins on the microstructural and nonlinear electrical properties of the ceramics. The prolonged sintering time normally is expected to disrupt the microstructural and to decrease the nonlinear electrical properties of the ceramics. The sample was prepared via solid-state method and sintered at 900 °C. XRD results shows that the MnV, GdMnO3, Mn2Nb2Zn2O9 and ZnV2O4 phase disappeared with increasing sintering time. The ZnO peak shift to the low diffraction angle from 47.5341□ to 47.4995° and the interplanar space increases slightly from 1.9129 to 1.9142 Å. The density decreases from 5.22 to 4.62 gcm−3. The average grain size decreases from 3.56 to 3.19 μm due to pinning action by Gd2O3 at the grain boundary which accelerate the annihilation of Zn and O elements as shown by EDX maps. Thus, the barrier height decreases from 0.67 to 0.65eV and nonlinear □ value is decreases as expected from 9.91 to 7.01 and correspondingly the breakdown field E1mA decreases from 88.48 to 71.04 V/mm at 210 min.

Keyword: Sintering time; Microstructural properties; Nonlinear electrical properties; Zn-V-Mn-Nb-Gd-Obased varistor; Low-voltage varistor