

Microstructural and nonlinear electrical properties of ZnO ceramics with small amount of MnO₂ dopant

ABSTRACT

A small amount of MnO₂ dopant was added to ZnO system to see the improvement of the ceramic varistor microstructural and nonlinear electrical properties. The samples were prepared using solid-state reaction method and the microstructure and nonlinear electrical properties of the ZnO-xMnO₂ system were investigated for $x = 0.011$ to 0.026 mol%, at three sintering temperatures, 1180°C, 1240°C and 1300°C for 1 and 2 h sintering time. The XRD and EDAX analyses showed that the main phase was ZnO while ZnMnO₃ and ZnMnO₇ as the secondary phases developed and distributed at the grain boundaries and triple point junction. The SEM observation revealed that prolonged sintering temperature and time improved the microstructure uniformity and strongly influences the nonlinear behavior of the samples. The maximum density and grain size have been observed at 92% of theoretical density and 10.8 μm , respectively and occur at the highest sintering temperature which is 1300°C. The value of nonlinear coefficient is found to increase with the increase of MnO₂ doping level up to 0.016 mol% and drop with further doping level increment for all sintering temperatures and time.

Keyword: MnO₂; Nonlinear coefficient; ZnO varistor