Sintering and Electrical Properties of Mn-doped ZnO-TeO_2 Ceramics

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Abstract : ZnO-based varistors have been widely used for voltage stabilization or transient surge suppression in electric power systems and electronic circuits. Recently, It has reported that the varistor behavior with nonlinear coefficient of 6~17 in Mn-doped ZnO.In this study we have chosen the composition of ZnO-TeO_2-Mn_3O_4 (ZTM) system to the purpose of whether varistor behavior appeared in doped ZnO by the solid state sintering or not. We investigated the sintering and electric properties of 0.5~3.0 at% Mn doped ZnO-1.0 at% TeO_2 system. Electrical properties, such as current-voltage (I-V), capacitance-voltage (C-V), and impedance spectroscopy were conducted. TeO_2 itself melts at 732℃ in air but forms the $ZnTeO_3$ phase with ZnO as increasing temperature and therefore retards the densification of ZnO to 1000℃. The average grain size of sintered samples was at about 3㎛ and decreased with increasing Mn contents. It was found that a good varistor characteristics were developed in ZTM system sintered at 1100℃ (nonlinear coefficient $\alpha \sim 60$). The results of C-V characteristics such as barrier height (Φ), donor density (N_d), depletion layer (W), and interface state density (N_t) in ZTM ceramics were $4x10^{17}$ cm^{-3}, 0.7 V, 40 nm, and $1.6x10^{12}$ cm^{-2}, respectively. It will be discussed about the stability and homogeneity of grain boundaries using distribution parameter (α) simulated with the Z(T)"-logf plots in ZTM system.