Synthesis mechanism of low-voltage Praseodymium oxide doped zinc oxide varistor ceramics prepared through modified citrate gel coating.

Abstract

High demands on low-voltage electronics have increased the need for zinc oxide (ZnO) varistors with fast response, highly non-linear current-voltage characteristics and energy absorption capabilities at low breakdown voltage. However, trade-off between breakdown voltage and grain size poses a critical bottle-neck in the production of low-voltage varistors. The present study highlights the synthesis mechanism for obtaining praseodymium oxide (Pr6O11) based ZnO varistor ceramics having breakdown voltages of 2.8 to 13.3 V/mm through employment of direct modified citrate gel coating technique. Precursor powder and its ceramics were examined by means of TG/DTG, FTIR, XRD and FESEM analyses. The electrical properties as a function of Pr6O11 addition were analyzed on the basis of I-V characteristic measurement. The breakdown voltage could be adjusted from 0.01 to 0.06 V per grain boundary by controlling the amount of Pr6O11 from 0.2 to 0.8 mol%, without alteration of the grain size. The non-linearity coefficient, α, varied from 3.0 to 3.5 and the barrier height ranged from 0.56 to 0.64 eV. Breakdown voltage and α lowering with increasing Pr6O11 content were associated to reduction in the barrier height caused by variation in O vacancies at grain boundary.

Keyword: Citrate gel; Praseodymium oxide; Varistors; Zinc oxide.