Accepted Manuscript

Influence of sintering temperature on microstructure and electrical properties of Er_2O_3 added ZnO-V_2O_5-MnO_2-Nb_2O_5 varistor ceramics

Samarpita Roy, Debdulal Das, Tapatee Kundu Roy

PII: S0925-8388(18)31179-4

DOI: 10.1016/j.jallcom.2018.03.302

Reference: JALCOM 45532

To appear in: *Journal of Alloys and Compounds*

Received Date: 28 November 2017

Revised Date: 22 March 2018

Accepted Date: 24 March 2018

Please cite this article as: S. Roy, D. Das, T.K. Roy, Influence of sintering temperature on microstructure and electrical properties of Er_2O_3 added ZnO-V_2O_5-MnO_2-Nb_2O_5 varistor ceramics, *Journal of Alloys and Compounds* (2018), doi: 10.1016/j.jallcom.2018.03.302.

Influence of sintering temperature on microstructure and electrical properties of Er_2O_3 added ZnO-V_2O_5-MnO_2-Nb_2O_5 varistor ceramics

Samarpita Roy[1], Debdulal Das[1], Tapatee Kundu Roy[2*]

[1]Department of Metallurgy and Materials Engineering, Indian Institute of Engineering Science and Technology, Shibpur, Howrah-711103, INDIA

[2]Variable Energy Cyclotron Centre, HBNI, 1/AF Bidhan Nagar, Kolkata-700064, INDIA

Abstract

The effect of sintering temperature (950 – 1100 ^oC) on the densification, microstructure and nonlinear electrical properties of 0.5 mol. % Er_2O_3 added ZnO–V_2O_5–MnO_2–Nb_2O_5 ceramics powder mixture was investigated. Microstructural characterizations by XRD and SEM coupled with EDS microanalyses confirm the development of equiaxed ZnO grains surrounded by different secondary phases, mainly Er-rich spinel phases in the intergranular layers and triple points. Image analyses reveal that the average size of ZnO grain increases from 1.8 to 7.2 µm with increasing sintering temperature from 950 to 1100 ^oC. Coarsening of grain structure is found to reduce the breakdown field (10286 to 2584 V cm^{-1}), and nonlinear exponent (150 to 26). The donor concentration, N_D increases from 2.2×10^{17} to 4.9×10^{17} cm^{-3} with increasing sintering temperature from 950 to 1100 ^oC, whereas, the depletion layer width, ω decreases from 56.4 nm to 37.8 nm. Typically, a fine-grained (1.8 µm) and dense (95% TD) varistor sample possessing a high value of nonlinear exponent ($\alpha = 150$); enhanced breakdown field (10286 V cm^{-1}) and leakage current density of 0.18 mA cm^{-2} could be made by conventional sintering technique at a reasonably lower temperature of 950 ^oC from the chosen multicomponent ZnO varistor system.

Keywords: Oxide materials; Ceramics; Sintering; Grain boundaries; Nonlinear exponent; Varistor

*Corresponding author: E-mail: tapatee@vecc.gov.in; Tel.: +91 33 23184462; fax: +91 33 23346871.