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SEVENTEENTH ANNUAL CONFERENCE

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Influence of Point Defects Concentration on Densification Process and Optical Properties of Sintered ZnO Ceramics

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Zinc oxide is one of the most studied materials due to its potential applications in electronics, optoelectronics and spintronics. In the forms of single crystal and thin-film ZnO could be used as UV and blue light emitter, while sintered ZnO-based ceramics are important as varistors, thermistors or wide-band gap semiconductors. Intrinsic defects, such as vacancies, interstitials and antisites, in the crystal structure of a ZnO strongly influenced its electrical and optical properties. Thus, understanding the behavior of intrinsic defects during densification of ZnO ceramics as well as correlation of the defects with band gap energy of final product is important to its application in opto-electronic devices.

In this study, the influence of point defects concentration on the densification process and optical properties of ZnO sintered ceramics was investigated. To obtain ZnO sintered ceramics with variety of point defects concentration we employed two starting powders with a different crystal structure ordering, as well different morphology and specific surface area. Sinterability of the powders was investigated by thermo mechanical analyzer; shrinkage data, collected in axial (h) direction during non-isothermal sintering with heating rates of 5, 10 and 20 °/min, were used to calculate activation energy of sintering process. Sintering of uniaxially pressed (P = 100 MPa) cylindrical compacts (ø 6 mm and h ≈ 3 mm) were done in air atmosphere by heating rate of 10 °/min up to 1100 and 1200 °C, and dwell time of 2 h. To study a crystal structure of the sintered samples XRD and Raman spectroscopy were used, for microstructural investigation field emission scanning electron micrographs were recorded while optical properties were determined by UV-Vis diffuse reflectance and photoluminescence spectroscopy. A detailed study shows that point defect strongly influenced densification process as well optical properties. Sintered ZnO ceramic with a high crystal defect concentration and nanosized grains shows band gap energy of about 2 eV while band gap energy increased with a decrease of defect concentration.