

THE STUDY OF BARIUM TITANATE ADDITION ON
MICROSTRUCTURE AND ELECTRICAL PROPERTIES
OF ZINC OXIDE BASED VARISTOR CERAMIC

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CERAMIC

By
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Thesis submitted in partial fulfilment of the
requirement for the award of the degree of
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THESIS CONFIRMATION AND APPROVAL

This is acknowledged and confirmed that thesis entitled: *The Study of Barium Titanate Addition on Microstructure and Electrical Properties of Zinc Oxide Based Varistor Ceramic* by Siti Noradilah binti Senin (S39239) have been checked and all the suggested corrections have been done. The thesis is submitted to School of Ocean Engineering, Universiti Malaysia Terengganu in partial fulfillment of the requirements for the award of the degree of Bachelor of Applied Science (Electronics and Instrumentation Physics).

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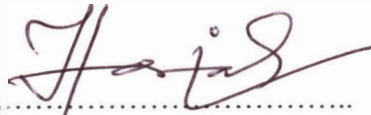
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I hereby declare that this thesis is the result of my own research except as cited in the references.

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THE STUDY OF BARIUM TITANATE ADDITION ON MICROSTRUCTURE AND ELECTRICAL PROPERTIES OF ZINC OXIDE BASED VARISTOR

ABSTRACT

In this research, the study of BaTiO₃ addition on the microstructure and electrical properties of ZnO based varistor ceramic have been studied. The ZnO is added with 3, 6, and 9 wt. % of BaTiO₃ by the solid-state method using planetary ball milling and sintered at 900, 1100, and 1300°C for 45 minutes. The sample of un-doped ZnO is prepared for comparison. X-Ray Diffraction (XRD) spectra for the commercial ZnO and BaTiO₃ confirmed that the samples do not have any impurity. From the XRD pattern analysis, samples exhibited a primary and secondary phases of the compound and high crystallinity. Scanning Electron Microscope (SEM) equipped with Energy Dispersive X-Ray Spectroscopy (EDX) images show an improvement of the grains size and uniformity of the microstructure of ZnO as the increasing of the wt. % of the BaTiO₃ and sintering temperatures. Then, the functional group is observed by Fourier Transform Infrared (FTIR). The Current-Voltage (I-V) characteristic measurement, the value of non-linearity coefficient is in the range of 1.0-15.0. In conclusions, the evolution of surface morphology due to BaTiO₃ addition is observed in the ZnO based ceramic varistor and is correlated to their electrical characteristics.

KAJIAN TERHADAP PENAMBAHAN BARIUM TITANIA TERHADAP MIKROSTRUKTUR DAN SIFAT ELEKTRIK VARISTOR ZINK OKSIDA

ABSTRAK

Dalam kajian ini, kajian pada penambahan BaTiO₃ terhadap mikrostruktur dan sifat-sifat elektrik varistor berasaskan ZnO telah dikaji. ZnO telah ditambah dengan peratusan berat (wt. %) BaTiO₃ sebanyak 3, 6, dan 9 wt. % yang disediakan melalui kaedah pepejal dengan menggunakan penggilingan bola planet dan disinter pada suhu 900, 1100, dan 1300 °C selama 45 minit. Sampel ZnO asli yang tiada campuran bahan lain telah disediakan juga untuk perbandingan. Hasil daripada spektrum Pembelauan sinar-X (XRD) untuk ZnO dan BaTiO₃ komersial telah mengesahkan bahawa sampel tidak mempunyai sebarang kekotoran. Dari analisis corak XRD, sampel sebatian tersebut mempamerkan fasa primer dan sekunder serta tahap kristal yang tinggi. Mikroskop pengimbasan elektron (SEM) yang dilengkapi dengan Spektroskopi Spektrum Energi Sinar-X (EDX) menunjukkan peningkatan saiz bijirin dan keseragaman mikrostruktur ZnO kesan daripada peningkatan wt. % BaTiO₃ dan peningkatan suhu sintering. Kemudian, kumpulan berfungsi telah diperhatikan melalui Transformasi Fourier Inframerah (FTIR). Pengukuran arus-voltan semasa (*I-V*) juga mendapati nilai pekali bukan linear adalah dalam julat 1.0-15.0. Sebagai kesimpulan, evolusi morfologi permukaan disebabkan oleh penambahan BaTiO₃ diperhatikan dalam varistor berasaskan ZnO dan telah dikaitkan dengan sifat-sifat elektrik mereka.