Investigation the Structure of the samples by Nonlinear Electrical Conduction for Field Grading in High-Voltage Applications

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***Abstract*-- Nonlinear composites and functional fillers are promising materials for field grading and stress control in high voltage application as due to their electrical parameters. A crucial aspect for the utilization of nonlinear composites is to control their nonlinear characteristics to fulfill specific field grading needs. The switching field is a key parameter that determines the electrical field threshold at which the composite material starts to display nonlinear characteristics. In this study, the structure of silicone rubber matrix with different concentrations of the ZnO microvaristor 70 wt. %, 60 wt. % and 50 wt. % and various manufacture procedures were investigated using SEM techniques. The measured nonlinear V-I characteristics of obtained samples were evaluated. The outcomes of this work provide a better understanding of the impact of the selected manufacturing procedures on the nonlinear characteristic and can support the design and optimization of high-voltage systems.**

Background & Main Results

SEM (scanning electron microscopy) is a type of imaging technology used to observe the surface structure and composition of materials at high magnification. Figure (1) shows the dispersion of microvaristors powder 70 wt.% in the silicone rubber matrix under 40 X magnification and it was observed that the smaller size grains of microvaristors were uniformly dispersed, which helps to build up a large number of particle contacts necessary to allow very large current conduction.

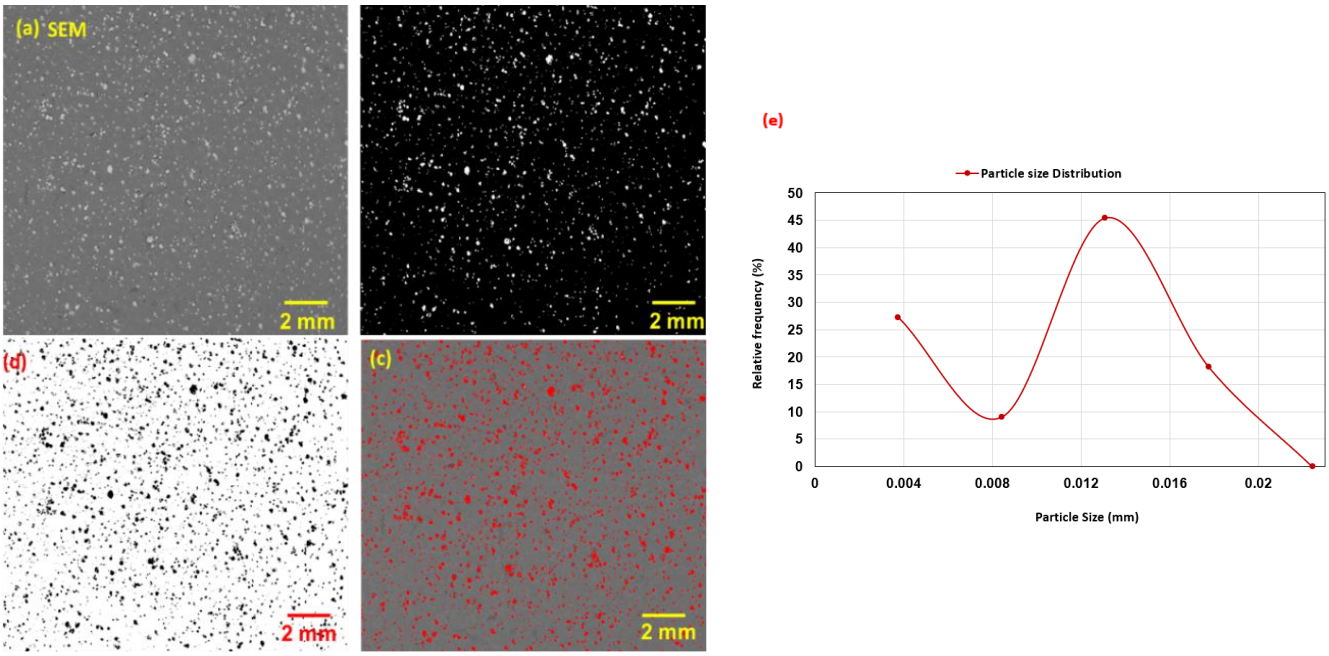

Figure 1. (a) Process SEM images on sample of silicone rubber with Microvaristor 70 wt. % (b) result of applying means filter to the same 2D image(c) segmented image with particles phases, where particles are rad, (d) particles are shown with different sizes (e) particles size distribution.

CONCLUSIONS

The microscopic evaluation of the compound was conducted using a Scanning Electron Microscope (SEM). Elemental studies, particle size, and microstructure were focussed upon, as well as the dispersion of microvaristors in the silicone rubber matrix. The results show that the microvaristor powder with different concentarions 70 wt.%, 60 wt% and 50 wt.% were well dispersed in the silicone rubber matrix.

REFERENCES

[1] R. Abd-Rahman, A. Haddad, N. Harid, and H. Griffiths, "Stress control on polymeric outdoor insulators using Zinc oxide microvaristor composites," IEEE Trans. Dielectr. Electr. Insul., vol. 19, no. 2, pp. 705–713, 2012, doi: 10.1109/TDEI.2012.6180266.

[2] H. Ahmad, A. Haddad, H. Griffiths, S. Robson, T. Nishimura, N. Tsukamoto, "Electrical characterisation of ZnO microvaristor materials and compounds", in IEEE Conference on Electrical Insulation and Dielectric Phenomena (CEIDP) 2015, pp 688-692, Ann Arbor, Michigan, USA, 18-21 October 2015.