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Synergistic Effect of ZnO Microspherical Varistors and Carbon Fibers on Nonlinear Conductivity and Mechanical Properties of the Silicone Rubber-Based Material

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Abstract

Polymeric materials filled with ZnO varistors microspheres can exhibit the intriguing nonlinear current-field characteristic that is promising for electrical field grading applications. However, the switching field of the composite material is hardly controllable by current approaches, and the nonlinear current-field characteristic of the composite material is attained at the expense of significantly compromised mechanical properties. In this study, we developed silicone rubber (SR)-based ternary composites containing ZnO microspherical varistors and carbon fibers (CF) for simultaneous control over the electrical and mechanical properties to satisfy the practical requirement in electrical field grading. The measured *J-E* characteristics showed that introducing CF into conventional ZnO microspherical varistors/SR binary composites could largely broaden the range of switching field and improve the nonlinear characteristic. The mechanical tensile tests of the ternary composite samples revealed remarkably enhanced mechanical properties compared with ZnO microspherical varistors/SR binary composites. This paper demonstrated the synergistic effect in tailoring the nonlinearity and mechanical performance of nonlinear polymeric composites for advanced field grading materials.

Keywords: ZnO microspherical varistor; A. Carbon fibers; B. Electrical properties; B. Non-linear behavior; B. Mechanical properties

1. Introduction

Stress control or electrical field grading is of importance in all fields of electrical and electronic insulation, including electrical systems for cable terminal insulation