A New Electro-Thermal Aging Model Based on Trapping and De-trapping Process in Polymeric Materials

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An investigation of space charge effects on the aging process of polymeric materials will be reported in this paper based on thermo-electrical stress. Aging mechanism is thermally activated, and electrically accelerated by presence of space charges. A physical origin of threshold temperature is involved and demonstrated based on the modification of the time function of the Eyring reaction rate theory. The derived model has some interesting features such as concentration of trapped and de-trapped charges, physical meaning behind its parameters. Under application of electric field, structure of polymeric material will be altered and form micro-cavity crazes. Therefore, conductivity of the materials should be considered as an explicit parameter as well. Acceleration of aging process due to trapped charges will be tested and incorporated into the life model through modification of the free energy barrier. This model will be applied to different polymeric materials samples under various temperatures and thicknesses to study its validity for both ac and dc applied fields.