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A New Physical Model for DC Partial Discharge in Polymeric Insulators

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Novel Physical Model for DC Partial Discharge in Polymeric Insulators

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Abstract

The physics of DC partial discharge (DCPD) continues to pose a challenge to researchers. We present a new physically-motivated model of DCPD in amorphous polymers based on our dual-defect model of dielectric breakdown. The dual-defect model is an extension of standard static mean field theories, such as the Crine model, that describe avalanche breakdown of charge carriers trapped on uniformly distributed defect sites. It assumes the presence of both high-energy chemical defects and low-energy thermally-recoverable physical defects. We present our measurements of breakdown and DCPD for several common polymeric materials in the context of this model. Improved understanding of DCPD and how it relates to eventual dielectric breakdown is critical to the fields of spacecraft charging, high voltage DC power distribution, high density capacitors, and microelectronics.

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