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The Effects of the Beta Transition on Dielectric Breakdown in LDPE

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Abstract

It is critical for many practical applications to understand how electrostatic discharge (ESD)—the permanent, catastrophic failure of an insulating material due to applied electric field—varies due to changing environmental conditions, including temperature and radiation dose. For instance, the beta transition is a solid-state transition that takes place as part of the glass transition in polymers. The glass transition temperature is a temperature range below which a polymer exhibits a glassy state that is hard and brittle, and above the range is soft and rubbery. Prior research conducted at USU suggests that there is a change in the electrical properties of low density polyethylene (LDPE) around its beta transition temperature, which is approximately 240 – 260 K. Standard step-up to electrostatic discharge tests were performed on LDPE using a custom high vacuum chamber with a liquid cooling system to cool the samples to the required temperature. This was done in order to better understand and determine what effects the beta transition has on the dielectric breakdown of LDPE.