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Partial discharge behaviour of biaxially orientated PET films: the effect of crystalline morphology

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Abstract

The relation between PD induced breakdown behaviour and crystalline and amorphous morphology of PET films used in photovoltaic devices has been explored and discussed in this work for the first time. Biaxially orientated PET films with and without $BaSO_4$ filler were isothermally annealed at various temperatures before partial discharge (PD) breakdown tests of the films to investigate the crystalline morphology effect. Attenuated total reflectance - Fourier transform infrared spectroscopy (ATR-FTIR) and differential scanning calorimetry (DSC) were used to study the changes of crystallinity and lamellar thickness of the samples. It was found that both PD resistances and PD lifetimes could be significantly improved when the samples were annealed at temperatures above 210°C. On the other hand, improvements were much less in the annealing temperature region between 180 to 210°C. This is because the thinner and less perfect lamellae formed by annealing at the lower temperatures are less effective at resisting either ion bombardment or electrical tree propagation. On the other hand, the formation of thickened and perfected lamellae produced at higher annealing temperatures can effectively increase the tortuosity of electrical tree propagation paths, thereby increasing the PD lifetimes.

Key words: poly(ethylene terephthalate); photovoltaic; partial discharge; morphology; annealing.

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