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Filler and additive effects on partial discharge degradation of PET films used in PV devices

Rong Tang[a], John J. Liggat[a*], Wah H. Siew[b]

[a]*WestCHEM, Department of Pure and Applied Chemistry, University of Strathclyde, Glasgow, G1 1XL, Scotland, United Kingdom.*

[b]*Department of Electronic & Electrical Engineering, University of Strathclyde, Glasgow G1 1XW, Scotland, United Kingdom.*

Abstract

A series of poly(ethylene terephthalate) (PET) films with different additives were subjected to identical electrical stresses to investigate their partial discharge (PD) degradation behaviour. Fourier transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM) and X-ray photoelectron spectroscopy (XPS) were used to study the surface chemistry changes of the degraded samples. The filled samples showed markedly better PD resistance and lifetime compared to the unfilled PET. A filler 'pile-up' effect has been directly observed for the filled samples and is proposed as the mechanism underlying the enhanced stability. PD-induced breakdown results also revealed that TiO_2 filled PET has a superior PD lifetime to $BaSO_4$ filled PET, which could be attributed to both the higher permittivity of the TiO_2 fillers and the voids that are created around the $BaSO_4$ particles during the film orientation process. Further improvements to PD resistance and PD lifetime, through the reduction of surface oxidation, are observed for a $BaSO_4$-filled sample additionally containing the UV stabilizer Tinuvin 1577.

Key words: poly(ethylene terephthalate), photovoltaic, partial discharge, fillers, UV stabilizer.

*CORRESPONDING AUTHOR FOOTNOTE. Ph: +44 (0)1415484351 email: j.j.liggat@strath.ac.uk