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Characterising electrical trees in nanocomposite epoxy-resin using partial discharge detection methods

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ABSTRACT

Modern polymer based solid electrical insulation technologies, whilst highly optimal for their function, have been shown to have a major flaw: susceptibility to electrical treeing failure mode. This dissertation investigates the possibility of using Partial Discharge (PD) detection techniques to monitor and characterise electrical trees in nanocomposite epoxy insulation. The experimentation is done by creating highly divergent electric stress in nanocomposite samples and monitoring PD magnitudes over time until failure. Furthermore, a remote monitoring system was designed to allow for constant monitoring from anywhere with an internet connection. The experimental results revealed several interesting findings. Electrical trees in unfilled insulation behave differently from those in nanocomposite insulation. The electrical trees that form in unfilled epoxy are of bush/branch type with the corresponding PDs comprising of both big (greater than 10 pC) and small (less than 10 pC) pulses throughout the lifetime of the tree. In nanodielectrics however, the PD magnitudes are generally smaller than in the unfilled dielectric. Moreover the PD patterns evolve through distinct phases as the trees propagate from inception to complete failure. These distinct phases show new behaviour not seen in unfilled insulation, with phases of complete silence and some displaying patterns similar to corona. The resulting patterns are analysed and auto-classified, using a program written for this purpose, before being used to develop a model to explain the observed behaviour.