Contribution ID: **312** Type: **Poster**

The Behaviour of Surface Discharges on a Liquid Nanocomposite Interface

Tuesday 20 June 2017 13:30 (1h 30m)

The addition of nanoparticles with conducting and semiconducting properties to liquid and solid insulation systems is a current area of active research interest. In liquid insulation the nanoparticles have been shown to improve the breakdown strength of certain liquids due to their ability to scavenge free electrons from the system. In solid nanocomposites improvements in the physical properties of the insulation system such as tracking resistance, mechanical strength and thermal conductivity, have been achieved. In terms of their dielectric properties the behaviour of these nanocomposites is complex and traditional approaches to determining these properties using the approaches of Bruggerman or Maxwell Garnet have not been successful. It is believed that the changes in the dielectric properties do not come simply from the properties of the nanoparticle itself but also from the changes in the structure in the matrix surrounding the nanoparticle. This leads to a 3 phase system with more complicated behaviour in both effective medium approximations and in percolation.

The optical and electrical behaviour of surface discharges, caused by the application of 50 Hz sinusoidal voltages in the range of 30 to 45KV, on epoxy based nano composites under mineral oil have been measured. The solid nanocomposites used contained either ZnO nano particles at concentrations between 0.1wt% and 3wt% or Al2O3 nanoparticles at 0.1wt% and 0.5wt%. The optical behaviour of the surface discharge has been quantified in terms of: maximum discharge channel length; integrated optical emission and fractal dimension. The electrical behaviour of the discharge has been quantified in terms of the measured partial discharge activity. The behaviour of the surface discharge activity is discussed in terms of the changes in these measured parameters as the applied voltage, the type of nanoparticle and the nanoparticle concentration is varied.

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Session Classification: Poster session II - Pulsed Power Physics and Technology, Components and HV Insulation

Track Classification: Pulsed Power Physics and Technology, Components and HV Insulation