Polymeric Insulation for High Voltage DC Application

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With growing interests in renewable energy, high voltage DC transmission has become a hot topic worldwide. Charge accumulation under high voltage DC is a major issue as its presence distorts the electric field, leading to premature failure. Significant reduction in DC flashover voltage has been observed by various studies and its maximum decrease may reach ~40-50% compared to AC or short-term strength [1]. We aim to chemically treat polymeric insulation and change charge transport characteristics of the material via fluorination process. In doing so, exceptional surface properties similar to fluoropolymers can be achieved without compromising the bulk characteristics of the original polymeric insulation [2]. The modifications in chemical components at the surface of polymeric insulation should in turn lead to corresponding modifications in electrical properties of the surface and suppress the charge accumulation.

Various fluorinating conditions will be experimentally investigated and the fluorinated samples will be electrically characterised and tested, so an optimal processing condition can be achieved to meet practical requirements as DC insulating material. Modelling and simulation of electric field distribution with new developed insulating material have been planned to help design an insulation spacer in high voltage DC GIS systems.

In this present paper, fluorinations of epoxy resins were carried out to suppress charge accumulation and consequently enhance flashover voltage. A surface flashover model with finger-like electrodes has been developed using COMSOL Multiphysics 3.5. Figure 1 shows the sample with electrodes arrangement geometry and the analysis region. The distance between the two electrodes is 8mm. The maximum electric field relaxation on the surface as well as inside the bulk of epoxy samples were performed for each fluorinating conditions. Identifying the influence of each fluorinating conditions on the electric field will help to determine the influence of fluorination modification on the electrical properties at the surface of polymeric insulation.

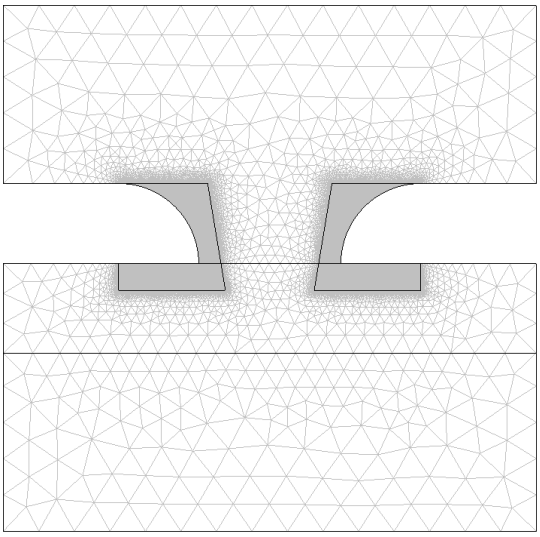

Figure 1: Analysis model for surface flashover of fluorinated epoxy using finger electrodes and finite element meshes

[1] E. Volpov, “Dielectric Strength Coordination and Generalised Spacer Design Rules for HVAC/DC SF6 Gas Insulated Systems”, IEEE Transactions on Dielectrics and Electrical Insulation, Vol. 11, pp. 950, Dec 2004

[2] Z. An, Q. Yang, C. Xie, Y. Jiang, F. Zheng and Y. Zhang, “Suppression of Charge Injection to Linear Low Density Polyethylene by Surface Fluorination Modification”, *in Proceedings of 2008 International Symposium on Electrical Insulating Materials*, Sep 2008, pp. 368.