Chapter 7
Epoxy Resin for GIS
Disc–Type Insulator

ABSTRACT

Epoxy resin is widely used in disc-type spacers of gas insulated switchgear (GIS), such as disc-type insulator, post insulator and so on. While surface flashover related to the existence of surface charge and tracking failure often occur on the spacer, which is a great threat to the application of GIS and the safety of entire grid. This chapter presents a study aimed at clarifying surface charge behaviors, surface flashover and tracking resistance of EX and EX/\(\text{Al}_2\text{O}_3\) composites. It is indicated that surface charge behaviors of EX charged by AC and positive pulse voltage are totally different from that charged by AC and negative pulse. And it can be concluded that the characteristics of surface charge behaviors are changed by adding nanoparticles. With increasing the filler content from 0 to 5 wt%, the relative discharge intensity, weight loss and pattern area of the specimens decrease, the last time of the tracking process increases.

INTRODUCTION

EPOXY resin (EX) has attracted increasing attention because of its excellent insulation properties and low cost (Iwata, 2016; An et al., 2016; Li et al., 2015; Nguyen et al., 2015; Ning et al., 2015). The addition of nanoparticles into epoxy can change the molecular structure and introduce some traps at the interfaces. The effects of nanoparticles on electrical properties have

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been investigated. It was found that the charge behavior can be affected by nanoparticles (Lewis, 2004; Tagami et al., 2008; Sarathi et al., 2016). For example, the surface flashover characteristics on solid dielectrics were found to be closely related to the charge behavior (Kumara et al., 2012; Kimura et al., 2002; He et al., 2016).

Many investigators have investigated the effect of nanoparticles on charge behavior (Hayase et al., 2006; Du et al., 2012; Perlman et al., 1987; Nath et al., 1990; Takada et al., 2008). Hayase et al reported that low density polyethylene (LDPE)/MgO nanocomposite at loadings higher than 0.5 per hundred (phr) of the base polymer showed a superior property to prevent the injection of space charge into the bulk (Hayase et al, 2006). Du studied the effect of TiO₂ nanoparticles on the dynamic behavior of surface charge accumulation and charge decay of Epoxy/TiO₂ nanocomposites. The obtained results showed that the charge accumulation and charge decay were restricted by nanoparticles (Du et al., 2012). Perlman et al showed that new deep traps were introduced by the titanium dioxide at all concentrations in polyethylene (Perlman et al., 1987). Using the same method, Nath et al concluded that charge storage in polyarylate increased with increasing dopant concentration to an optimum at 10 wt% titanium dioxide (Nath et al., 1990). Takada reported that trap depth and the effective range of the induced dipole due to nanoparticles depended on the relative dielectric constant, size, and shape of the nanoparticles (Takada et al., 2008).

For the purpose of obtaining more excellent properties, a lot of work has been done by adding nano fillers into epoxy including nano-Al₂O₃. Thomas et al have discovered that the adding of Al₂O₃ reduces the PD magnitude in LDPE (Alapati et al., 2012). Edin et al have found the dimension of the nano-particle has great influence on the magnitude of tan δ (Jäverberg et al., 2012). Tanaka et al have investigated that nano particles impact the initiation treeing time (Tanaka et al., 2008; Chen et al., 2010). They have also suggested that the nano-Al₂O₃ particles increase the dielectric breakdown strength of epoxy composites (Li et al., 2010). Meanwhile, Moraveji et al have studied that the thermal conductivity increases when adding nano-Al₂O₃ into a fluid (Moraveji et al., 2012). It is shown that the adding content of nano particles has a great effect on the dielectric performance of polymer nanocomposites (Du et al., 2012).
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