Chapter 5
Trap Property and Charge Transmission in PE

ABSTRACT

The electrical properties of the dielectric are achieved by affecting the charge transfer process. The trap characteristics have an important influence on the electrical properties of the dielectric by affecting the charge transfer process. Aggregation and trap level characteristics of nanographene on low density polyethylene (LDPE). The direct current conductivity, breakdown strength, trap level distribution, space charge distribution, and charge mobility of nanocomposites were investigated. The experimental results show that the interface region between graphene and polymer introduces many deep traps in the forbidden band of nanocomposites, which can reduce the trapping process of charge and inhibit the accumulation of space charge. This indicates that the addition of nanoscale graphene has a significant improvement in the electrical performance of high voltage DC cables, which will provide a reference for production and application.

INTRODUCTION

In 1994, the concept of nano-dielectrics was proposed, which has become a research hotspot in the field of electrical and electronic engineering (Lewis, 1994). Numerous studies have shown that nanocomposites have better electrical, thermal and mechanical properties than the original polymers. Nanocomposites (Nelson, 2002; Tanaka, 2004; Nelson, 2005; Krivda, 2012;

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Tanaka, 2013), with excellent electrical properties, have low electrical conductivity, high breakdown strength and enhanced space charge resistance, making it These new properties as a new generation of insulating materials are believed to be due to the high specific surface area of the nanofillers resulting in the formation of large amounts of deep traps in the polymer-filler interface region (Nelson, 2004; Lewis, 2004; Tanaka, 2005).

In previous studies, including metal oxides (such as alumina, silica, titania, magnesia, and zinc oxide), nitrides (such as boron nitride and aluminum nitride), montmorillonite (MMT), etc. The filler is incorporated into the polyolefin (Kumara, 2016; Tanaka, 2011; Zha, 2008; Jung, 2010; Li, 2014). In addition, the surface modification of the nanofiller can reduce the agglomeration of the nanofiller and achieve better dispersibility in the polymer matrix. Therefore, as a unique nanoscale filler, graphene has only the thickness of the atomic layer and has up to 2630. The huge specific surface area of m2 / g enhances the interfacial region of the polymer filler (Huang, 2009; Lau, 2013; Li, 2013; Rafiee, 2009; Li, 2013; Fim, 2013), which may significantly increase the interfacial area of the polymer-filler and exert greater insulation potential.

For nanocomposites using graphene, previous research has focused on thermal, mechanical, and electrical properties. Graphene/LDPE nanocomposites are reported to be semiconductors when the filler content exceeds a critical percolation threshold of 3.8% by volume (Fim, 2013). 1 wt% Graphene/LDPE nanocomposites have enhanced mechanical properties and non-linear conductivity (Gaska, 2017). So far, little research has been done on the electrical properties and trap level characteristics of graphene-doped nanocomposites with extremely low filler content. According to the operating temperature of polyethylene insulation in HVDC transmission cables, it is necessary to study the effects of ambient temperature on charge transfer and trap level characteristics.

In terms of electrical properties, space charge is usually caused by the charge injected by the electrode and the ionization of chemical groups up to tens of kilovolts/mm under a DC electric field (Wu, 2017; Montanari, 2011; Li, 2016). This will represent the electric field distribution and accelerate the aging, degradation or even destruction of the insulation (Lan, 2014; Wang, 2016). The occurrence of voltage levels, the miniaturization of electrical equipment and the increase in operating temperature will further increase the space charge injecting and accumulating, which has become one of the key issues in the development of pe-based insulation.

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