Electrical Breakdown Strength of Boron Nitride Polyethylene Nanocomposites

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There is a growing demand for the design of high-performance insulators for high voltage applications. It was proposed that the addition of nanofillers to a polymer could potentially enhance the electrical properties of insulators when compared to the conventional unfilled or microfilled polymers [1]. These materials have captured the interest of many researchers worldwide since then, as present dielectric materials could benefit from improvements in properties such as dielectric strength, dielectric loss, electrical and thermal conductivity, and permittivity that nanodielectrics offer. However, many of the underlying principles remain uncertain, such as the polymer/nanofiller interface, and researchers are still exploring solutions to common challenges faced by nanodielectrics such as nanoparticle agglomeration [2].

The work presented in this paper is based on a hexagonal boron nitride nanocomposite in a polyethylene blend host polymer. A polyethylene blend composed of 80% low density polyethylene (LDPE) and 20% high density polyethylene (HDPE) is chosen as the polymer matrix since it has a higher electrical breakdown strength than pure LDPE. Hexagonal boron nitride was chosen as a nanofiller because of its attractive properties for high voltage applications such as high dielectric strength, high thermal conductivity, and mechanical robustness [3]. A solution blending method is used to mix the nanoparticles in the polymer as better quality materials and nanoparticle dispersion are achieved.

This paper will investigate the AC electrical breakdown behaviour of the prepared polymer nanocomposite materials. The electrical breakdown strength of the unfilled polymer will be compared to the untreated hexagonal boron nitride filled polymer at different loading levels. The addition of this nanofiller is expected to alter the dielectric strength due to changes in the material's structure. The chemical structure of hexagonal boron nitride is illustrated in Figure 1, where there is an equal number boron and nitrogen atoms firmly bound together. The breakdown results will then be analysed using a two-parameter Weibull distribution.

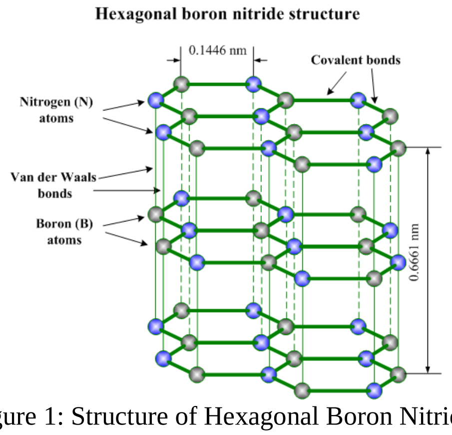

Figure 1: Structure of Hexagonal Boron Nitride

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