Polyethylene Nanocomposites – A Solution Blending Approach

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Polymer nanocomposites are expected to be the potential dielectric materials of the future due to the unique electrical properties that these materials could exhibit. The interfaces between the polymer and the nanofiller are thought to be the critical contributing factor to the unique electrical properties. Although much effort has been expended in investigating the potential dielectric benefit of such newly emerging materials, many uncertainties remain unanswered, and much remains to be explored [1]. For example, dispersion of nanoparticles in polymers is still a significant challenge. Due to their small size, nanoparticles tend to agglomerate rather than appear as single particles when incorporated into polymers. This happens even though the polymers should be relatively compatible with the particular nanoparticle. Therefore, various preparation techniques are proposed to obviate, or at least minimise, such unwanted clustering effects.

In our previous study [2], the preparation of polyethylene nanocomposites through nanosilica dispersion in methanol was reported, where the breakdown strength was negatively affected due to the poor dispersion of nanosilica. In this study, we investigate another possible solution blending route, i.e., through the initial dispersion of nanosilica in xylene. Polyethylene (80: 20 ratio of low density polyethylene to high density polyethylene) containing 0 wt%, 2 wt%, 5 wt% and 10 wt% of nanosilica were investigated. After etching, scanning electron microscopy reveals the lamellar texture of the base polymer and provides evidence concerning the dispersion state of the nanosilica. The melting and crystallisation behaviours of the materials have been evaluated by differential scanning calorimetry, supported by polarized optical microscopy. The influence of nanosilica on the AC breakdown strength is finally described.

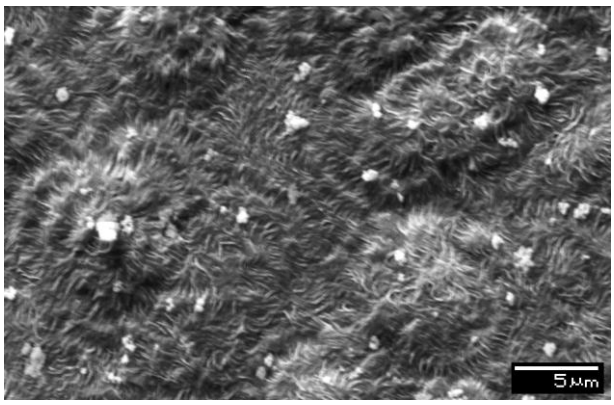

Figure 1: SEM micrograph showing the dispersion state of 2wt% of nanosilica in polyethylene

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[2] K. Y. Lau, A. S. Vaughan, G. Chen and I. L. Hosier, "On the Effect of Nanosilica on a Polyethylene System", *Journal of Physics: Conference Series*, vol. 310, no. 1, 012008, 2011