LDPE-GNP NANOCOMPOSITES: MANUFACTURING AND PROPERTIES

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Abstract

An overview of the properties of highly structured, low density polyethylene-graphene nanoplatelets (LDPE-GnP) nanocomposites is here presented [1-2]. The effects of composition, nanofiller size and processing conditions on the mechanical, rheological, electrical, gas barrier and thermal nanocomposite properties were considered. Samples prepared by means of the dry-coating method were extruded, resulting in a strong anisotropy in the extrudates' morphology. GnP nanoplatelets were oriented in the extrusion direction for all shear rates and flow histories investigated, as confirmed by scanning electron microscopy. Moderate improvements in mechanical properties were recorded, owing to the poor GnP-PE interface. The rheological percolation was determined via nonlinear parameters to be around 7.5wt%. Electrical measurements revealed a nonlinear field dependent behavior. At electric fields below 20 kV/mm significant reductions of the through-plane conductivity were recorded, whereas above a crossover effect was observed. The gas permeability showed a drastic decrease of this property with increasing filler content. A clear correlation was found between permeability and free volume fraction in the material, the latter evaluated by means of positron annihilation spectroscopy. A strong anisotropy of the thermal conductivity was achieved, with the in-plane conductivity increasing with GnP content.

References

[1] Gaska et al., Gas Barrier, Thermal, Mechanical and Rheological Properties of Highly Aligned Graphene-LDPE Nanocomposites, Polymers 9, 294 , 2017
[2] Gaska et al., Electrical, Mechanical, and Thermal Properties of LDPE Graphene Nanoplatelets Composites Produced by Means of Melt Extrusion Process, Polymers 9, 11 , 2017