

MANUFACTURING AND CHARACTERIZATION OF NANOCOMPOSITES BASED ON PLA GRAPHENE NANOPATELETS FOR 3D PRINTING APPLICATION

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Abstract

The main objective of this work is the nanocomposite manufacture from graphene nanoplatelets and PLA for application in additive manufacturing. To characterize this new material's mechanical and thermal properties, the DSC, DMA, and FEG-SEM techniques were used. The results showed that the filler/matrix interaction of the mechanical mixture resulted in a good interface in comparison with the solvent mixture. However, a slight decrease in melting temperature was observed and an increase in both crystallinity degree and glass temperature.

Introduction

The polymeric filament based on PLA (Polylactic Acid) is the most used in the Additive Manufacturing process called FFF (Fused Filament Fabrication) [1], which consists of heating, extrusion and layering of the material in order to obtain a desired geometry. To improve the properties of this material, it is possible to add reinforcing fillers such as Graphene Nanoplatelets (GNP), which consist of stacking 10 to 100 sheets of Graphene [2], a two-dimensional (2D) material composed of honeycomb-shaped carbon atoms. The main objective of this work is the fabrication and characterization of the physical-mechanical properties of filaments for 3D printers produced with the incorporation of 10% w/w GNP in the PLA matrix.

Materials and Methods

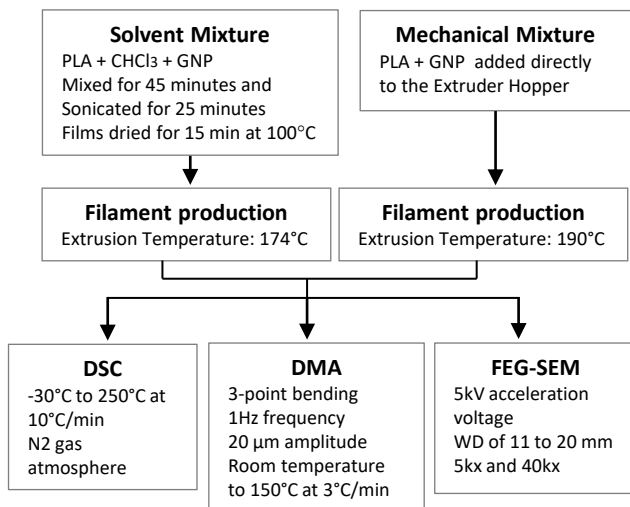


Fig. 1 – Materials and Methods Workflow

Results and Discussions

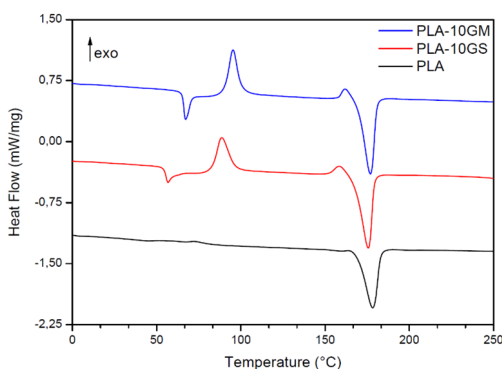


Fig. 2 – Thermogram for PLA, PLA-10GS and PLA-10GM

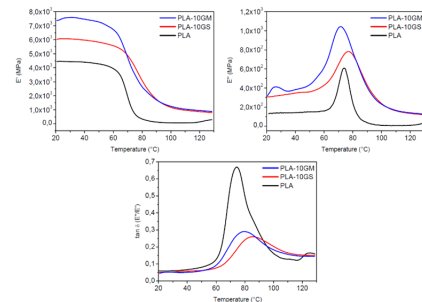


Fig. 3 – Dynamic-Mechanical Properties: a) E', b) E'' and c) tan δ

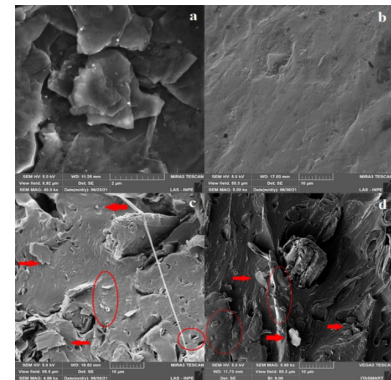


Fig. 4 – FEG-SEM Images of a) Graphene Nanoplatelets, b) PLA, c) PLA-10GM and d) PLA-10GS

Conclusion

It was showed that the nanofiller contributed to the increase in the PLA polymer stiffness, in addition to an increase in glass transition temperatures and a drop in melting temperature. It was also observed that the filler/matrix interface had a good interaction in the PLA-10GM sample. More studies are needed to obtain a better filler/matrix dispersion while maintaining good interaction, an essential factor when dealing with composite materials.

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