FEASIBILITY STUDY OF THERMOPLASTIC NANOCOMPOSITE FOR ESD APPLICATION USING ADDITIVE MANUFACTURING

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ABSTRACT

Nanocomposite materials are the multiphase solid materials where one of the phases has one, two or three dimensions less than 100 nanometers (nm). Nanocomposite materials play a vital role in a wide range of applications in aerospace, automotive, sports, and biomedical industry because of their adaptability to different situations and desirable properties. The major goal of this study is to produce and characterize polyamide 6/nanographene platelets (NGP) nanocomposites that have improved electrical resistivity for electrostatic charge dissipation applications with minimal reduction in mechanical properties. Polyamide 6 and nanographene platelets were melt blended using industry size co-rotating twin-screw extrusion. Tension and electrical resistivity test samples for neat PA6, PA6/NGP with 3wt. %, 5wt. % and 7wt. % loadings were produced using fused deposition modeling (FDM) on commercially available open source 3D printer. Electrical resistivity was measured using Keithley Megohmmeter Instrument. Mechanical characterization includes tensile test of the samples. The recommended electrical resistivity range of nanocomposite material system for the ESD applications is 10^6 – 10^{12} Ω-cm. Stress release annealing helped in improving both mechanical and electrical properties of the material system. Mechanical test results of neat PA6 and 7 wt % loading of NGP into PA6 showed improved properties while annealed 3 and 5 wt % loading showed droppage. % elongation of 7 wt % Pa6/NGP dropped after annealing, as recrystallization takes place in annealing and increases the ductility of the material. Electrical resistivity was improved by annealing and all nanomodified

PA6 material system showed resistivity in the range of 10^{11} ohm-cm, all qualifying for ESD applications. Out of all nanomodified PA6 material 7 wt % PA6/NGP was preferred as its showed both improved mechanical and electrical properties.

Key Words: Additive manufacturing, 3D printing, Fused deposition modelling (FDM), Twin screw extrusion, Electro Static charge dissipation, Annealing.