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Assessing Electrical Properties of Novel Pani /Acrylic Composites For 3d Printing

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3D printing technologies are becoming an important part of the Industry 4.0, although research into new materials capable of providing new features is necessary to increase their applications. To develop new conducting polymer composites, the use of multi-walled carbon nanotubes as conducting filler into UV-curable resins has been usual. However, intrinsically conducting polymers such as polyaniline (PANI) are gaining popularity as conductor fillers due to their electrical behavior, good environmental stability, and easy low-cost synthesis. This work pursues the development of polymer composites with electrical properties based on polyaniline, suitable for additive manufacturing. The composites were formulated adding increasing amounts of PANI-HCl into a photopolymerizable acrylic-resin and cured under a LED Spot-Curing System. The obtained composites were characterized using Scanning Electron Microscopy (SEM), Thermogravimetric Analysis (TGA) and electrical conductivity measurements. To assess the suitability of the new resins for 3D printing their rheological properties and the depth cure were measured. An electrical conductivity of 1,28x10-3 S/cm was achieved with a 4,8 wt% PANI content. The composite roughness increased with PANI content due to the immiscibility between filler and resin and the PANI tendency to agglomerate. All composites were thermally stable up to 100ºC. For a composite with 4.8wt% PANI, the minimum exposure for the transition from liquid to solid was 2.20 J/cm2 with a penetration depth of 193 μm. An increase in viscosity was measured with increasing filler concentration. Besides, an important change in the slope of the viscosity curves was observed from 4.25 wt% PANI in agreement with the enhancement in conductivity values. So, the content of PANI in a basic photocurable acrylic formulation was fixed based on rheological and electrical conductivity analysis.

Keywords: 3D Printing, Electrically Conducting Polymer, Polyaniline, Polymer Composite, UV curing

Biography:

Goretti Arias Ferreiro is a PhD Student in the area of Applied Physics at the Universidade da Coruña. She became graduate in Chemical Engineering from the University of Santiago de Compostela (Spain) in July 2017. She received the Master Studies Certificate in the Energy Efficiency and Utilization Program, Universidade da Coruña, in August 2018. Currently, she is a PhD student of the Group of Polymers of the Universidade da Coruña, where she is carrying out her doctoral thesis titled "Development of conducting photocurable resins for additive manufacturing" in Applied Physics. The goal of the project is to obtain low-cost materials 3D printable for electrical applications.

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