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Study of Graphene Oxide-based 3D Printable Composites as Potential Ink for Vat Polymerization Digital Light Processing

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Structured Abstract

Background: VAT polymerization is a 3D printing technology that use photopolymerization to create 3D objects. A liquid polymer resin is exposed to ultraviolet (UV) radiation to convert it into a solid. The concentration of GO plays a critical function in controlling solution viscosity, agglomeration and hence 3D printing efficiency. At lower concentrations of GO dispersion, the system's liquid-like behaviour renders 3D printing impossible to implement. Higher concentrations of GO exhibit gel behaviour with a high elastic modulus. Our aim is to determine the optimum concentration of Graphene oxide (GO) at range 10-25 mg in photopolymer resin (PUA) for Vat Photopolymerization Digital Light Processing.

Methods The GO powder was dissolved in the 200 mL PUA resin and stirred for 45 minutes until homogenised. All GO/PUA blend compositions were created using the polymer blending method with GO weight percentages of 10, 15, 20, and 25%. Next step is acquiring a value of viscosity and torque percentage (%) by using viscometer. The reading began with rotation frequency (rpm) from 10, 12, 20, 30, 50, 60, and 100 rpm with different spindle sizes (05 and 06). Characterization of the sample was done by Fourier Transform Infrared Spectroscopy (FTIR) and Scanning Electron Microscopy (SEM).

Results: The viscosity of PUA/GO composite decreases as the concentration of GO increases. GO may produce chemical interactions with PUA because it contains functional groups such as hydroxyl (-OH), carboxyl (-COOH), and epoxy groups, all of which are characteristic of GO. These functional groups can aid the interaction and bonding between PUA and GO, leading to an improvement in the mechanical characteristics of the composite material. After that, the surface of PUA with addition of GO is observed to be smooth and clear without any formation of much agglomeration or voids. This is clearly proven that GO has fully dispersed and homogenous in photopolymer resin.

Conclusion: It can be concluded that by the addition of GO as potential ink can change the molecular interactions of PUA by creating chemical bonds, hydrogen bonds, encapsulation, surface functionalization, and functioning as a nanofiller. These interactions can improve the mechanical characteristics, adhesion, and stability of a composite material.

Keywords: Potential ink , VAT Polymerization, Viscosity, Digital Light Processing (DLP)

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