Additive Manufacturing of Polymeric Material with Metallic Structures via Electrically Vat Photopolymerization

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1. Introduction

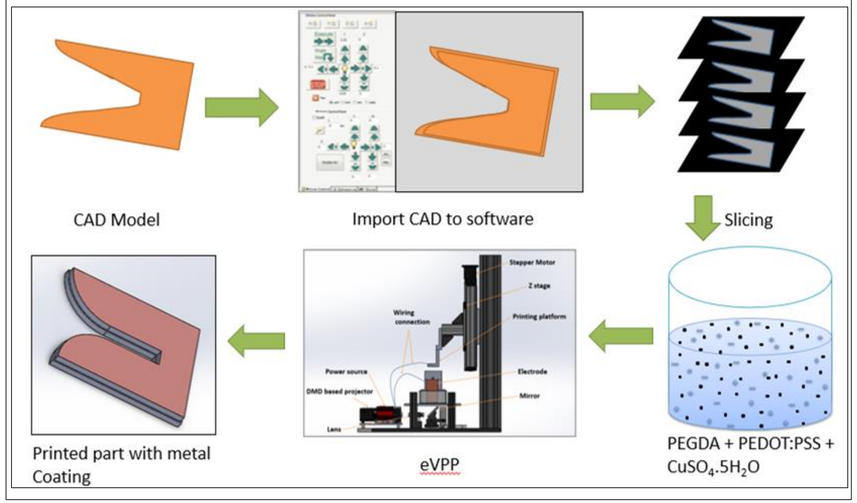
The metallization of local areas of 3D-printed plastic structures has attracted a significant amount of attention. However, metal and plastic Additive Manufacturing technologies are incompatible with each other due to the significant difference in their associated process parameters. In recent research, the conductivity of highly conducted polymer show considerable potential to be used as a surface on which electroplating can take place.

Current research shows a two-step metal deposition process: 1. Fabricate part using 3D printing processes, such as selective laser sintering, fused deposition metal, Electron beam melting, direct metal laser sintering, and Stereolithography.

2.The printed part will be metal deposited. There are processes such as chemical vapor deposition, physical vapor deposition, electroless plating, and electroplating. Compared with other processes, electroplating is superior with characteristics such as strong metal adhesion, room temperature environment, and low cost.

2. Abstract

Metallic structures on polymer surfaces are gaining a lot of interest due to their unique applications such as ICs, antennas, and metamaterials. Most Additive Manufacturing (AM) can only fabricate 3D objects using non-heterogeneous materials, and how to fabricate the polymeric objects with controllable metallic structures is a critical challenge in AM. In this work, an electrically assisted mask image projection based stereolithography was developed to control the metallic depositions on the polymer matrix composite for various applications. The research will deliver a novel AM process that can fabricate heterogeneous materials using a one-step process, which will promote multifunctional and multi-material AM research.



3. Construction of eVPP

Overview of the eVPP process

In the eVPP process, the photocurable material was deposited on the surface of a transparent resin tank layer by layer, and each layer of the photocurable material was selectively cured to form a solid pattern when a 2D light beam was projected from the bottom optical system.

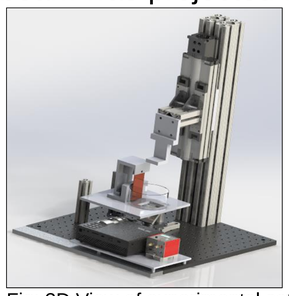


Fig: 3D View of experimental setup

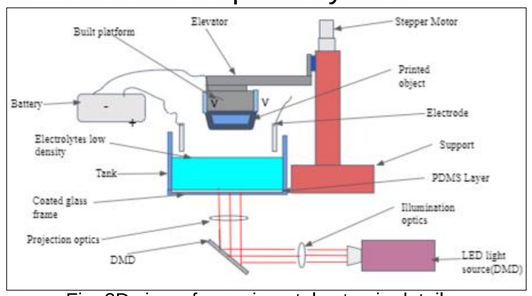


Fig: 2D view of experimental setup in details

Electrically assisted copper growth

Ion transfer in the electrolyte solution for metal deposition is with the help of an electrode. Electric current through resin which will act as an electrolyte is passed by putting an electrode in the resin tank. Two electrodes are placed parallel to each other at a certain distance from the printing platform. Electric current to the printed part connected by the power supply of a 30 V battery. Different voltage and deposition times are tested in the experiment to study the deposition.

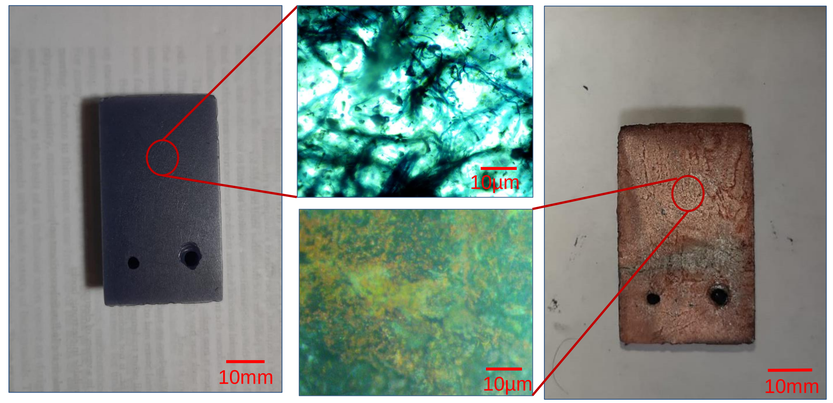


Fig: Polymer printed

Fig: Polymer Cu electroplated

4. Future Wok

- Study of material composition for the deposition.
- Study of deposition thickness and quality of deposition with printing parameter
- Study of electrical properties of printed parts.

5. Acknowledgment

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