A novel electrical conductive resin for stereolithographic 3D printing

Summary

Additive manufacturing (AM) or 3D printing, is a three-dimensional fabrication technique in which a model designed by Computer Aided Design (CAD) is built layer-by-layer. The fabrication technologies based on AM are able to make complex geometries that cannot be created using traditional manufacturing process (i.e., forging, injection molding, etc.).

Nowadays scientific and industrial applications on 3D printing is rapidly growing up and, in parallel, is increasing the interest to develop novel printable materials especially for stereolithography (SL). The SL resins are epoxy or acrylate based monomers/oligomers, which undergo a cationic or radical photopolymerization. Inside those resins some fillers, e.g. carbon or silver nanoparticles, metal powders or composite polymers, are added to increase the electrical conductive properties.

One of the most employed conductive polymers, which registered great interest in recent years, is the poly(3,4-ethylenedioxythiophene): poly(styrenesulfonate) PEDOT:PSS called Clevios™ PH1000. Its optical transparency, tuneable electrical conductivity and high flexibility, make this copolymer one of the most used from energy storage devices to electrochemical sensors. In this work, an electrically conductive resin based on acrylate matrix was developed, studied and characterized using the PEDOT:PSS particles precipitated from Clevios™ PH1000.

First steps consisted in understanding the composition of the Clevios™ PH1000, and the possibilities to remove the PSS group using different treatments. Afterward, the dispersion of the PEDOT:PSS particles inside a Poly(ethylene glycol) diacrylate (PEGDA) resin was optimized and the surfactant and PEDOT:PSS concentration to achieve e stable conductive resin for SL was studied.

The main part of the PhD research activity was dedicated to characterize the PEGDA:PEDOT resin and explore the possible applications in energy storage devices, gas sensing and finally for cell culture devices.

The PhD research activity on High Performance & Smart Manufacturing has been held at the Materials and MicroSystems Laboratory of Politecnico di Torino (ChiLab).