Development of DLP-3D printable functional materials

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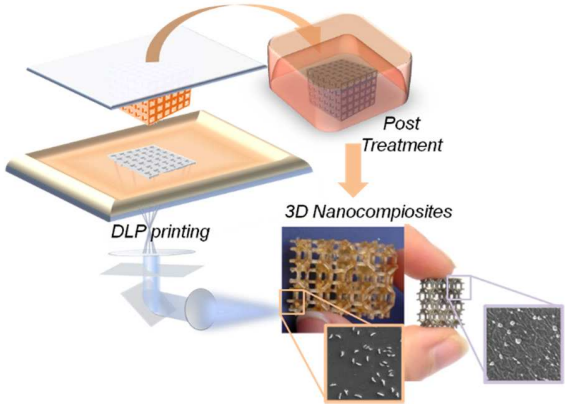
Additive Manufacturing Technologies, also known as 3D printing, have broken into public consciousness over the past last years, becoming appealing methods for the fabrication of solid forms with controlled geometry. Such techniques are showing great potentialities that make them suitable for a variety of application fields: from biomedicine to electronics and even further.
Currently there are over thirty different types of additive manufacturing technologies. Their operation can be based on different physical principles and requires the use of different materials, however all have in common the particularity of building the objects layer by layer. The type of 3D printer chosen for an application often depends on the materials to be used and on the resolution needed.

A brief overview on 3D printing principles and apparatus will be given mainly focusing on the polymer technologies. Subsequently the research developed in the IIT laboratories will be presented.
The works carried out are focused on the development of new materials for the printing techniques based on photopolymerization, and, in particular, for digital light processing (DLP).
With such a technique, it is possible to tailor the final properties of the printed object by choosing the right components of the reactive liquid formulations. A large variety of systems can be conceived for the production of structures with advanced properties and functions; the good balance between final properties and printability has to be found for every system.

Part of the seminar will be focused on new DLP 3D printable materials that allows the fabrication of objects with improved mechanical properties. Different strategies can be followed ranging from the use of common reinforcing filler (e.g. carbon nanotubes), to the addition of liquid precursors of the reinforcing phase that enable the in situ generation of the filler into the printed parts.



Sketch representing one possible approach for the DLP production of 3D nanocomposites

The last part of the presentation will show the development of functional materials for more specific applications. The choice of the right components brings the desired functionalities, enabling the production of intrinsically functional objects. Following this idea, a soluble silver precursor can be exploited to in situ generate nanoparticles to obtain object with enhanced conductivity or the addition of suitable functional agents can enable the immobilization of biomolecules on 3D printed structures that can be used as biosensors.

Several approaches can be followed to achieve the required properties: these studies open the possibility of developing functional objects with complex geometries through a simple but very precise process.

Short CVs

Bio Ignazio Roppolo, Ph.D.

Ignazio Roppolo obtained a Bachelor degree in 2006 and then a Master degree in 2008 in Materials Engineering from Politecnico di Torino. Afterwards, he achieved a Ph.D. in Materials Science from Politecnico di Torino in 2012 with a Thesis on photoluminescent materials. After some months as research assistant at Politecnico di Torino, he moved to Italian Institute of Technology(IIT), Center for Sustainable Future Technologies, in 2012. His research activity is mainly focused on the development of photocured materials and photoinduced chemical reactions. He worked on the realization of functional polymeric nanomaterials spanning from photoluminescent materials to graphene, comprising sensors and materials for electronic. More recently he moved his interests towards the development of smart formulations for 3D printing, mainly for SLA/ DLP technologies. He is author of more than 30 papers on international peer-reviewed journals and several book chapters; at last in these years he spent some time as visiting researcher in Canada (McGill's University), France (Ecole Polytechnique) and Portugal (Universidade de Aveiro).

Bio Annalisa Chiappone, Ph.D

Annalisa Chiappone obtained her Bachelor degree (2006) and her Master degree in 2008 in Materials Engineering from Politecnico di Torino. In the frame of the Erasmus students exchange program she also achieved the French Master Degree (Master 2) on "Polymer for Advanced Technologies" from the University J. Fourier in Grenoble. In 2012 she received her Ph.D. in Materials Science from Politecnico di Torino; her doctorate, in collaboration with the "Centre Technique du Papier" in Grenoble, was focused on lingo-cellulosic materials for the development of reinforced polymer electrolytes for lithium batteries applications. In 2012 Annalisa moved to the Italian Institute of Technology(IIT), Center for Sustainable Future Technologies, as post doc researcher. Until 2015 her research activity was mainly focused on polymeric materials and composites for energy or electronic applications, exploiting the photopolymerization and light induced functionalization processes. Since 2015 her research topic has moved to the development of new 3D printable formulations for SLA/ DLP technologies. She is author of about 30 papers on international peer-reviewed journals and 2 book chapters; science communication is one of her interests.