DIGITAL LIGHT PROCESSING OF MULTIFUNCTIONAL MAGNETO-BASED NANOCOMPOSITES

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The revolution of 4D printing allows combining smart materials to additive processes to create behavioral objects that are able to respond to external stimuli, such as temperature, light, electrical or magnetic fields. It follows then, that the synthesis of novel printable responsive-materials is currently at the bedrock of academic research. Besides, an ever-increasing attention is also being given to the synergetic incorporation of nanofillers within printable matrices so as to craft and modulate the functional properties of the resulting composites in a multiscale approach, where both embedded fillers and polymer matrices play an active role.[1-2]

Within this framework, a method for fabricating multifunctional polymer nanocomposites by means of Digital Light Processing (DLP) 3D printing is here presented. In particular, the approach entailed integrating two distinct functions into a photocurable poly(ethylene glycol) diacrylate (PEGDA) resin, namely, i) iron oxide nanoparticles (Fe_3O_4 NPs), to enable the DLP printing of magneto-reactive components and ii) silver nitrate ($AgNO_3$), as a precursor for the photogeneration of silver nanoparticles (Ag NPs) during a post-printing UV-irradiation process,[3] to give to the printed nanocomposites additional electrical properties and bactericidal traits. The printing parameters were optimized to reproduce highly complex 3D-architectures, the printed nanocomposites have been fully characterized and their multifunctional properties were demonstrated.

Finally, some insights will be given on the possibility to further expand the applications of 3D/4D printed magnetic nanocomposites exploiting the assembly or patterning of the nanofillers during the printing process through the use of a modified commercial DLP printer allowing to control both the intensity and the spatial direction of the applied magnetic field.[4] This may envisage the fabrication of a new class of nanocomposites with superior functional properties given by their unique anisotropic architectures.

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4 G. Rizza, A. Cosola, "A magnetic device configured to be installed on additive manufacturing apparatuses, enabling magnetically-assisted 3D printing of composite elements", European Patent application No. EP23201535.4, filed October 4, 2023 (patent pending)