New frontier for 3D printing develops state-of-the-art soft materials able to self-heal

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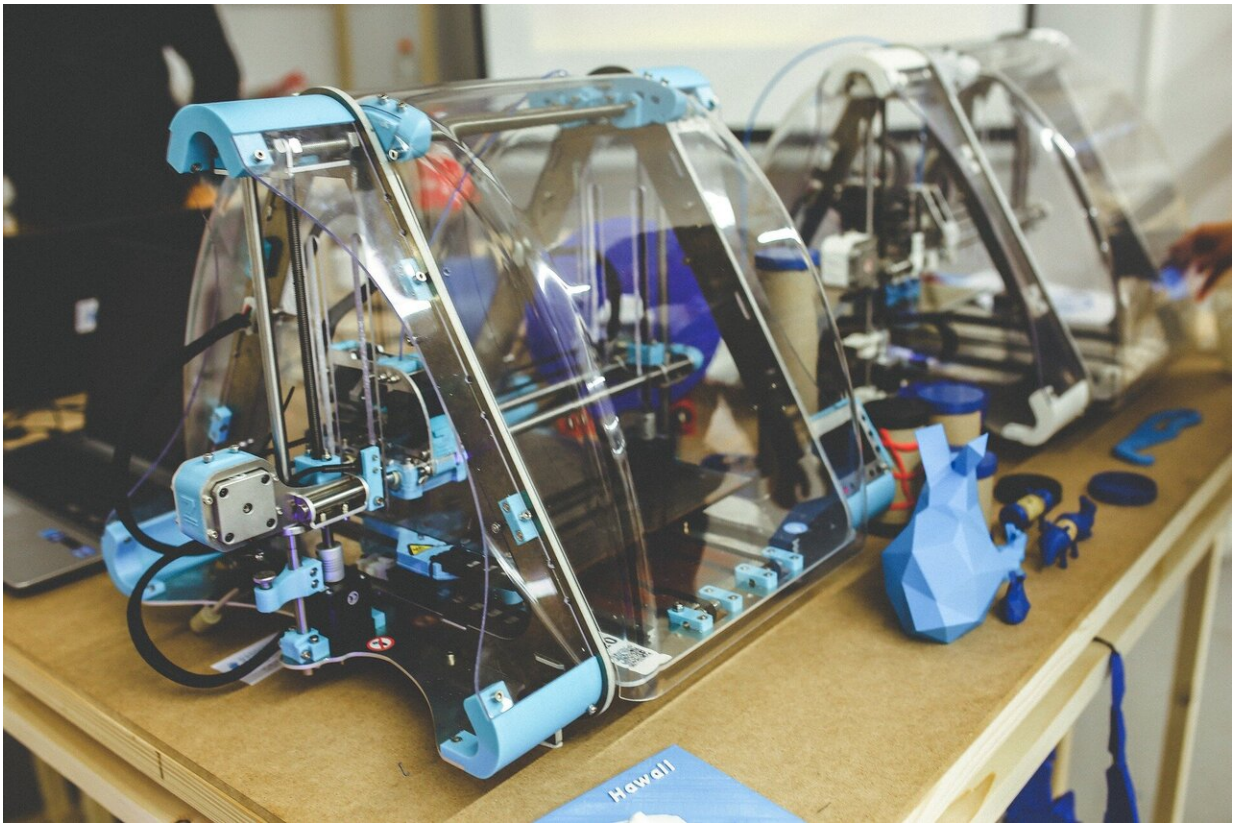

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The scientific community is focusing its research into the multiple applications of hydrogels, polymeric materials which contain a large amount of water, that have the potential to reproduce the features of

biological tissues. This aspect is particularly significant in the field of regenerative medicine, which for a long time has already recognized and been using the characteristics of these materials. In order to be used effectively to replace organic tissues, hydrogels must meet two essential requirements: Possessing great geometric complexity, and after suffering damage, being able to self-heal independently, exactly like living tissues.

The development of these materials may now be easier, and cheaper, thanks to the use of 3D printing: The researchers in the MP4MNT (Materials and Processing for Micro and Nanotechnologies) team of the Department of Applied Science and Technology of the Politecnico di Torino, coordinated by Professor Fabrizio Pirri, have demonstrated for the first time the possibility of manufacturing hydrogels with complex architectures capable of self-healing following a laceration, thanks to 3D printing activated by light. The research was published by the prestigious journal *Nature Communications* in an article entitled "3D-printed self-healing hydrogels via Digital Light Processing."

Up to now, hydrogels either with self-healing or modelable properties in complex architectures using 3D printing had already been created in the laboratory, but in the present case, the discovered solution encompasses both features: Architectural complexity and the ability to self-heal following damage. In addition, the hydrogel was created using materials available on the market, processed using a commercial printer, thus making the approach proposed extremely flexible and potentially applicable anywhere, opening new possibilities for development both in the biomedical and soft-robotics fields.

The research was carried out in the context of the HYDROPRINT3D doctoral project, funded by the Compagnia di San Paolo, in the frame of "Joint Research Projects with Top Universities" initiative, by the Ph.D. student Matteo Caprioli, under the supervision of the DISAT researcher Ignazio Roppolo, in collaboration with Professor Magdassi's research

group of the Hebrew University of Jerusalem (Israel).

"Since many years," Ignazio Roppolo recounts, "in the MP4MNT group, a research unit coordinated by Dr. Annalisa Chiappone and I is specifically devoted to development of new materials that can be processed using 3D printing activated by light. 3D printing is able to offer a synergistic effect between the design of the object and the intrinsic properties of materials, making possible to obtain manufactured items with unique features. From our perspective, we need to take advantage of this synergy to best develop the capabilities of 3D printing, so that this can truly become an element of our everyday life. And this research falls right in line with this philosophy."

This research represents a first step towards the development of highly complex devices, which can exploit both the complex geometries and the intrinsic self-healing properties in various application fields. In particular, once the biocompatibility studies underway at the interdepartmental laboratory PolitoBIOMed Lab of the Politecnico have been refined, it will be possible to use these objects both for basic research into cellular mechanisms and for applications in the field of regenerative medicine.

More information: Matteo Caprioli et al, 3D-printed self-healing hydrogels via Digital Light Processing, *Nature Communications* (2021). DOI: 10.1038/s41467-021-22802-z

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