SELF-HEALING HYDROGELS PRINTED BY PHOTOINDUCED 3D PRINTING TECHNIQUES FOR BIOMEDICAL APPLICATIONS

Maria D'Aloia[1,2,3], Ignazio Roppolo[2], Francesca Frascella[2]

[1]Department of Chemistry, Biology and Biotechnology, University of Perugia, Via Elce di Sotto 8, 06123 Perugia, Italy, [2]Department of Applied Science and Technology, Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129 Turin, Italy, [3]Center for Sustainable Future Technologies, Italian Institute of Technology, Via Livorno 60, 10144 Turin, Italy

Self-healing hydrogels (SHHs) are becoming increasingly important in biomedicine because of their similarity to biological tissues and their ability to recover from damage. Because of these characteristics, SHHs can serve as ideal 3D scaffolds for regenerative medicine [1]. So far, such hydrogels have been processed mainly via extrusion-based technologies, limited in design and resolution [2]. In order to obtain more complex objects with better resolution, in this study light-induced 3D-printing (Digital Light Processing – DLP) technique has been exploited. This research work deals with the development of a biocompatible, self-healable and photo-reactive hydrogel, able to be 3D printed through DLP. The printed structures were characterized mechanically and chemically, to find possible application in cartilage tissue engineering. A commercial DLP printer and water-soluble, commercially available materials were used to fabricate the hydrogel. In particular, thiol-ene polymerization has been exploited in the printing process, while boronate-ester bond chemistry plays a role in self-healing ability. The printing process was optimized by adding a natural radical scavenger based on tannic acid. In such conditions, complex 3D objects containing up to 85% water were printed (Fig. 1). The ability to self-repair was evaluated by cutting the 3D printed specimens and bringing the two ends together: after 48h, the specimen is capable of self-standing, while after 72h, it withstands up to 75% elongation (Fig. 2). Up to 3 cycles of breaking and self-healing on the same specimen have been performed, although the maximum elongation is reduced to about 20%. The resulting hydrogel was characterized in terms of NMR spectra, rheological properties, swelling abilities, resistance in aqueous environments, tensile and compression characteristics. Finally, biocompatibility and cytocompatibility tests will be performed to verify applicability in tissue engineering.

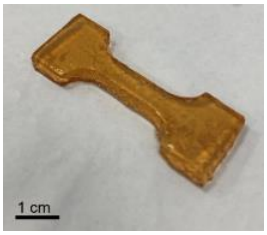

Fig. 1. *3D printed structure*

Fig. 2. *Self-healing ability after 72h at room temperature*

References

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