Use of boronic-azodye towards 3D printing self-healing hydrogel

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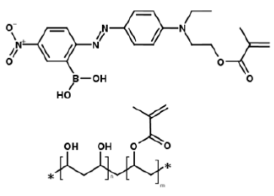
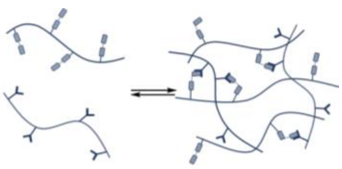
In the biomedical field a very active branch of research concerns the development of functional hydrogels. When composition and morphology of hydrogels are appropriately designed, they can find various applications, especially in the field of tissue engineering. Above all, synthetic and/or natural hydrogels are used as artificial systems capable of replacing or promoting the regeneration of damaged tissues. So far, this type of hydrogel has been processed by conventional methods; however, those approaches are not able to reproduce the complex inner structure and some properties of tissues like self-healing capabilities. Herein, we present a light- regulated self-healing hydrogel processable through 3D printing by using a commercial Digital Light Processing (DLP) printer.
A dye based on azobenzene was employed. Azo dyes can undergo cis-trans configurational changes when irradiated at a specific wavelength. Additionally, azobenzene was modified with attached boronic acid groups; these functional groups can form dynamic covalent boronate ester bonds with a diol [1]. As for the polyol, hydrated polyvinyl alcohol (PVA) methacrylate has been used because, as reported in the literature, it is the most suitable for forming polymer networks by reacting with boronic acid through boronate ester bonds [2].
The hydrogels were first characterized in terms of printanbility through rheology testing, then the mechanical properties were tested throw dynamic mechanical analysis and sweeling test, in order to verify the compatibility of the hydrogel with human tissues. Finally, a protocol has been developed to verify the self-healing capabilities.
The proposed approach enables 3D printing of hydrogels objects with complex architecture, with mechanical properties similar to human tissues and with self-healing capabilities.





References

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2. Zhang, Ze Ping, Min Zhi Rong, e Ming Qiu Zhang. *Progress in Polymer Science* 80: 39–93.