WATERLOO | ENGINEERING

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Self-Healing Zwitterionic Hydrogels for Soft Robotic Applications

Hydrogels with inherent self-healing, anti-fouling, and biocompatible properties are highly desirable as structural materials for medical soft robotics. Numerous existing self-healing hydrogels are based on chemically cross-linked networks that rely on dynamic covalent bonds for their self-healing properties. The self-healing of such hydrogels usually requires external energy sources, such as heat and light, or guest molecules, such as acid or base generators, to facilitate the scission of covalent bonds. Both of the aforementioned strategies can impose undesirable limitations on real-world medical applications. Hence, finding alternative solutions to achieve self-healing with high efficiency in biocompatible hydrogels is of great importance. Here, we report a biocompatible, anti-fouling, and physically crosslinked hydrogel that displays inherent self-healing properties. Our system is based on random copolymers of sulfobetaine (SB) and either Methacrylic acid or poly(SB-co-AAc). The electrostatic interactions between the positively and negatively charged sections of the SB monomers, and the intra- and inter-molecular hydrogen bonds present in the network provide the hydrogel with dynamic healable properties. We have also employed cellulose nanocrystal (CNC) to promote physical crosslinking and enhance the mechanical properties of the hydrogel without compromising its healing efficiency. The system demonstrates a self-healing ability that is independent of the duration the segments are separated prior to healing.

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