Self-Healing Hydrogels: The Next Paradigm Shift in Tissue Engineering?

Given their durability and long-term stability, self-healable hydrogels have, in the past few years, emerged as promising replacements for the many brittle hydrogels currently being used in preclinical or clinical trials. To this end, the incompatibility between hydrogel toughness and rapid self-healing remains unaddressed, and therefore most of the self-healable hydrogels still face serious challenges within the dynamic and mechanically demanding environment of human organs/tissues. Furthermore, depending on the target tissue, the self-healing hydrogels must comply with a wide range of properties including electrical, biological, and mechanical. Notably, the incorporation of nanomaterials into double-network hydrogels is showing great promise as a feasible way to generate self-healable hydrogels with the above-mentioned attributes. Here, the recent progress in the development of multifunctional and self-healable hydrogels for various tissue engineering applications is discussed in detail. Their potential applications within the rapidly expanding areas of bioelectronic hydrogels, cyborganics, and soft robotics are further highlighted.

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