

Stimuli-Responsive Biomolecular Hydrogels for Medical Applications

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Introduction

The success of hydrogels as a biomedical platform is demonstrated by their current wealth of applications. They stand at the forefront of biomaterial, medical device, drug delivery and regenerative health applications due to their versatility and biocompatibility. Their hydrophilic nature enables the uptake of copious amounts of water, mimicking the extracellular matrix and providing tissue-like characteristics in three-dimensions (3D). The properties of the overall hydrogel polymer are highly influenced by their corresponding monomer units allowing unique tailoring of hydrogel motifs to selective functional requirements. Common synthetic hydrogel motifs include: poly(acrylic acid), poly(acrylamide), poly(ethylene glycol) (PEG), poly(vinyl alcohol) (PVA), poly(2-hydroxyethyl methacrylate) (HEMA), poly(2-hydroxypropyl methacrylate) (PHPMA) and poly(N-isopropylacrylamide) (PNIPAM). Polymers are manipulated further by: combining monomer units to form co-polymer blends of varying ratios; altering the method of manufacture; varying cross-linking density and controlling amorphous/crystalline morphology. Whilst research into synthetic hydrogels are ongoing and has led to the clinical translation of a number of successful platforms, there has been a re-emergence in the study of natural-based hydrogels with inherent biodegradability and improved biofunctional properties. Hydrogels abundant throughout nature include agarose, alginate, elastin, collagen, gelatin, chitosan, fibrin,