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Stimuli-Responsive Biomaterials for Tissue Adaptation and Regeneration

Yuanchi Zhang[1,*] and Yuxiao Lai[1]

[1]Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, 1068 Xueyuan Avenue, Shenzhen, 518055, China

[*]Corresponding Author: Yuanchi Zhang. Email: zhangyc@siat.ac.cn

ABSTRACT

Tissue damage poses a significant burden on patients' daily lives and has long driven the search for effective clinical treatments [1]. Tissue regeneration is a complex and comprehensive process that requires detailed consideration of the biomaterials' effects on the shape, systemic response, and microenvironment of the damaged sites. Recent decades have witnessed the development of stimuli-responsive biomaterials for satisfying the specific requirements such as irregular shapes and dynamic microenvironments at defective sites [2]. These smart materials have capabilities to alter their macro/microstructures and properties upon exposure to external stimuli such as heat, light, water, electricity, ultrasound, and pH value, which can dynamically adapt to the structure and bioactivity of injured tissues for enhancing therapeutic efficacy. Our group has developed a series of stimulus-responsive biomaterials e.g. shape memory polymers and functionalized hydrogels for tissue adaptation and regeneration [3-5]. For example, we first designed and synthesized shape memory polyurethane composites with coupled and bioactive molecular networks for improving their mechanical properties, memory effects and biological performances. In addition, we also constructed shape memory polymers and hydrogels with supporting, fixing, adhesion and/or biocompatible functions for adapting structures and bioactivities of defective tissues. Stress interaction, bioactive ions release, and hydrogen bonding at material-tissue interfaces have been significantly enhanced using interfacial modulation strategies. We further demonstrated their applications in bone regeneration, tumor treatment, and biosensing through in vitro and in vivo studies. Therefore, we envision these stimuli-responsive biomaterials have huge potentials for effective tissue regeneration and functional reconstruction.

KEYWORDS

Stimuli-responsive; tissue Adaptation; interfaces; regeneration

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