

Biomimetic sclerotization of chitin and chitosan to improve mechanical properties in wet condition

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Chitosan and chitin are widely used structural polymers for biomedical applications because it has many favorable properties. However, one of the most critical drawbacks regarding the use of chitosan and chitin as biomedical materials are its poor mechanical properties in wet conditions. Here, we designed a method to improve the mechanical properties of chitosan in wet conditions and minimized the swelling behavior of chitosan film due to water adsorption by mimicking the sclerotization of insect cuticles and squid beaks, that is, catechol-mediated crosslinking. The biomimetic chitosan composite film was prepared by mixing chitosan with 1-3,4-dihydroxyphenylalanine (DOPA) as a catecholic crosslinker and sodium periodate as an oxidant. The catechol-mediated crosslinking provided a sevenfold enhancement in the stiffness in wet conditions compared to pure chitosan films and reduced the swelling behavior of the chitosan film. This strategy expands the possible applications for the use of chitosan composites as load-bearing biomaterials.