Biomimetic Chitosan Composite with Improved Mechanical Properties in Wet Conditions

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Chitosan is one of the widely used structural polymers with biomedical applications because it has many favorable properties. However, one of the most critical drawbacks of chitosan as a biomedical material is its poor mechanical properties in wet conditions. Here, we have designed a method to improve mechanical properties in wet conditions and water-resistance of chitosan film by mimicking catechol cross-linking mediated sclerotization of insect cuticle and squid beak. The biomimetic chitosan composite film has been prepared by mixting chitosan with L-3,4-dihydroxyphenylalanine (DOPA) as a cross-linker and sodium periodate (0-3 wt%) as an oxidant. DOPA-meditated cross-linking on chitosan film raised glass transition temperature (Tg) of chitosan film up to 22 °C, provided 7-fold enhancement in stiffness in wet condition over pure chitosan film, and improved the resistance of the chitosan film to water and acetic acid. This strategy expands the possible applications for the chitosan composite as a load-bearing biomaterial such as a tough tissue, a bone composite additive, or a suture thread.