Synthesis and Characterization of Stimuli-Responsive Hydrogels Derived from CMC and PNIPAM for Tissue Engineering

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Abstract:

Over the past decade, hydrogels have been a prominent class of materials in tissue engineering. However, concerns have been raised about their low stress-bearing capacity and reduced thermal conductivity, which limit their application in tissue engineering. One such improvement is the interpenetrating (IPN) and semi-interpenetrating network (Semi-IPN) hydrogels. This research aims at the synthesis of dual stimuli-responsive polymers, specifically temperature and pH-responsive semi-interpenetrating polymer networks (Semi-IPNs), based on CMC and PNIPAM, through free radical polymerization. The mass ratio of CMC to NIPAM to crosslinker is a key factor influencing the network structure and properties of CMC/PNIPAM semi-IPN hydrogels. The prepared hydrogels were structurally characterized by FTIR, and their sol-gel phase transitions were studied by the test tube inversion method, in parallel with dynamic rheological measurements at different pH values. The analysis results demonstrate that the CMC/PNIPAM hydrogels exhibit a sol-gel phase transition temperature at around 32˚C with mechanical properties slightly depending on pH values. Moreover, the rheological measurements also showed variation with pH and PNIPAM concentration. This research further involves the addition of nanolaminate materials to enhance hydrogel performance and assess their potential in tissue engineering applications.

Keywords:

Hydrogels, Drug Delivery, Stimuli Responsive, pH, Temperature.