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Preparation and characterization of a thermal responsive of poly(*N*-isopropylacrylamide)/chitosan/gelatin hydrogels

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Abstract. Synthesis of interpenetrating polymer network (IPN) of chitosan-gelatin (Cs-Ge) (as a primary network) and *N*-isopropylacrylamide (NIPAAm) monomer (as the secondary network) was carried out with different ratio. Its structure was characterized by FT-IR, which indicated that the IPN was formed. The memberanes were studied by swelling, weight loss with time. The interior morphology of the IPN hydrogels was revealed by scanning electron microscopy (SEM); the IPN hydrogels showed a interpenetrated network of NIPAAm/chitosan has layers with more minute stoma and canals compared to interpenetrated network of NIPAAm/gelatin. Lower critical solution temperature (LCST), equilibrium swelling ratio (ESR) and de-swelling kinetics were measured. The DSC results noticed that LCST of IPN hydrogels with different ratio of Cs/Ge/PNIPAAm are around 33±2℃. The ESR obtained results showed that with a ratio of Cs/Ge/NIPAAm: 1/1/6, the swelling ratio increased drastically from room temperature to 36℃ but with a ratio of Cs/Ge/PNIPAAm: 1/3/6, decrease significantly at the same condition. Therefore the hydrogels have been changed from a hydrophilic structure to a hydrophobic structure. Furthermore with an increase in temperature from room to the LCST, the ESR of IPN with higher concentration of (PNIPAAm) and (Ge) decreases but de-swelling kinetics of them are faster. Due to the suitable and different kinetics of de-swelling and the equilibrium swelling ratio (ESR) in various proportions, and because of the morphology inside the mass which confirms other tests, these hydrogels are very appropriate as a smart thermosensitive hydrogels with rapid response.

Keywords: gelatin; chitosan; *N*-isopropylacrylamide; thermosensitive hydrogel

1. Introduction

Hydrogels are generally hydrophilic polymer networks which absorb sufficient water without being dissolved in water. Hydrogels, particularly smart hydrogels, are of particular interest to various industries due to their high capacity in responding and creating changes in shape and volume resulting from different external and environmental simulations (Mishra *et al.* 2011). Among polymers sensitive to the environment, those sensitive to temperature have been used extensively in various applications in biomedical fields such as drug delivery, optics and material science (Li *et al.* 2009, Carreira *et al.* 2010). Poly *N*-isoptopylacrylamide (PNIPAAm) is related to

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