OP 8 - Physico-chemical Behavior of Chitosan Grafted N-Isopropylacrylamide Copolymers

M. Recillas-Mota[1], L. Silva[1], F.M. Goycoolea[2], C. Peniche[3], M. Rinaudo[4],
W. Argüelles-Monal [1]

[1]CIAD - Unidad Guaymas, Carret. al Varadero Nacional Km 6.6, Guaymas, Sonora 85480, Mexico - [2]CIAD - Unidad Hermosillo, Carret. Victoria Km 0.6, Hermosillo, Sonora, Mexico - [3]Centro de Biomateriales, Univ. de La Habana, La Habana 10400, Cuba – [4] CERMAV-CNRS, 601 Rue de la Chimie, Grenoble Cedex 9, France

Stimuli-responsive polymers are of utmost importance for producing intelligent materials for applications like in biomedical and biotechnological fields. It is well known that chitosan is a pH-responsive polymer, while poly(N-isopropylacrylamide) (NIPA) is thermosensitive. In the present work chitosan-g-NIPA copolymer was synthesized as already described. The aim of this contribution is to evaluate the physico-chemical behavior of this copolymer and its hydrogels and membranes.
Copolymers with different composition were obtained by changing monomer and initiator concentration. Chitosan-g-NIPA copolymers were readily soluble in acidic media, and were characterized by proton NMR spectroscopy, potentiometric and conductimetric titrations.
On one hand, a sample with a fraction of amino substituted units equals 0.23 (grafted DP 3), was dissolved in 10 % acetic acid at different polymer concentrations, namely: 0.1, 1 and 2 % (w/w) (solution pH=2), and the influence of polymer concentration was studied by micro-DSC (microDSC-IIIa, Setaram) and by dynamic oscillatory strain-controlled viscoelastic measurements (RFS II, Rheometrics). Data shows that a sol-gel endothermic transition occurs during heating at around 20°C, with small hysteresis during the cooling process. The enthalpy and storage modulus values were proportional to the polymer concentration.
On the other hand, copolymer solutions at 1 % (w/w) of the above mentioned sample were prepared at different pH values between 2.0 and 4.7. In this case, the gel point temperature decreased as the pH increased, which was detected by both calorimetric and rheological measurements. This dependence suggests that the neutralization of the polymer chain favors interchain association probably via increasing hydrophobic interactions giving rise to a decrease in the temperature of the gel point.
The swelling process of membranes exhibits fickian behavior, the diffusion coefficient being estimated through a non-linear fitting process considering the case of diffusion through a plane sheet with surfaces kept at constant concentration. These membranes showed a swelling-deswelling response to periodical changes in pH and temperature.