Transport of Uncharged and Charged Probes in Poly(N-isopropylacrylamide-*co*-acrylic acid) Gels Swollen by Alcohols: Voltammetric Studies

Wojciech Hyk, Edison Ruiz, and Malgorzata Ciszkowska

Department of Chemistry, Brooklyn College, CUNY, Brooklyn, NY 11210-2889

Polymeric gels are three-dimensional networks of crosslinked polymeric segments swollen by a solvent. In some cases a gel can contain up to 99 % solvent. This is a rather unusual way in which large amounts of liquid can be maintained "solid", and therefore, gels possess many advantages characteristic of both the liquid and solid state of matter. The knowledge of the transport mechanism and, in particular, diffusion coefficients of ions and molecules in gels is of great importance in such applications as gel electrolytes for batteries, gel-based sensors, and gels in separation techniques.

In this work, transport of uncharged and charged ferrocene derivatives, used as electroactive probes, was studied in poly(N-isopropylacrylamide-*co*-acrylic acid) gels, NIPA-AA (Figure 1), swollen by various alcohols using steady-state voltammetry at platinum microelectrodes. A series of five simple alcohols (from methanol to 1-pentanol) has been chosen. NIPA-AA gels exhibit temperature-induced discontinuous volume phase transition while swollen by water. Interestingly, the exchange of the swelling agent to non-aqueous solvent, e.g. alcohol, prevents this feature to occur. Following aspects of the transport phenomena in NIPA-AA/alcohol gels are emphasized: (1) swelling properties of the gels in various alcohols; (2) evaluation of diffusion coefficients and activation energy of the transport of electroactive probes in the gels over a wide range of temperatures and ionic strengths; (3) comparison of diffusivities of probes determined in the NIPA-AA gels and those in corresponding alcohol solutions; and (4) electrostatic interactions between charged probes and charged polymeric network and their influence on transport properties of charged species in NIPA-AA gels.

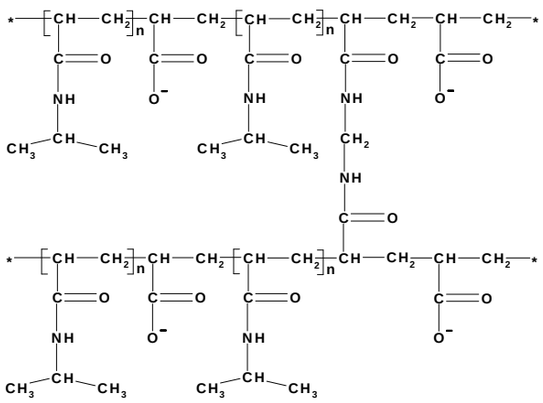

Figure 1. Schematic structure of N-isopropylacrylamide-*co*-acrylic acid copolymer.