Journal of Chemical Physics 2006 vol.125 N23

# Dielectric study of neutral and charged hydrogels during the swelling process

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## Abstract

Dielectric spectroscopy measurements of conductivity were applied for understanding the change in the internal morphology of the neutral and permanently charged polyacrylamide (PAAm) hydrogels during the swelling process. For the first time four distinct peaks (each corresponding to a different swelling stage) in the conductivity of the neutral gel were observed during the swelling of this gel. These peaks are related to the distribution of dense polymer regions (they are defined as the "blobs") appearing in a microstructure of the given PAAm gel having at least four average sizes. For the charged gel the heterogeneity decreases due to the internal electric field of the charged sites. Thus, this characteristic behavior in the conductivity becomes almost negligible for the gel charged with permanent S O3- groups. It seems this fact causes considerable decrease in amplitude of the peaks and overall decrease the conductivity during the whole swelling process especially at high frequencies. The new theory of dielectric relaxation based on the fractional kinetics containing the complex power-law exponents was used for verifying these swelling processes and received an excellent confirmation in description of the real part of the complex conductivity Re [ (ω)] by the fitting function that follows from the suggested theory. The calculated power-law exponents describe the behavior of Re [ (ω,m m0)] in the available frequency range (30 Hz-13 MHz) and for all values of the relative masses (volumes) measured in the process of the experiment. The excellent coincidence between the new theory and measured data gives a possibility to suggest more reliable physical picture of the swelling process that takes place in neutral/charged gels. © 2006 American Institute of Physics.

http://dx.doi.org/10.1063/1.2349480