



BALTIC POLYMER SYMPOSIUM 2018

PROGRAMME AND PROCEEDINGS



*Jurmala,
Latvia
September 12-14*

KINETIC FEATURES OF FORMATION OF SUPRAMOLECULAR HYDROGELS BASED ON L-CYSTEINE, SILVER NITRATE AND METAL HALIDES

V.S. Laguseva, S.D. Khizhnyak, A.I. Ivanova, P.M. Pakhomov

Physical Chemistry Department, Tver State University, Tver, Russia

The study of gelling processes in supramolecular hydrogels based on low-molecular weight compounds (amino acids and their derivatives) is of scientific and practical interest. Low-concentration hydrogels based on L-cysteine (L-Cys), silver nitrate and halides of various metals exhibiting antimicrobial activity could find application in various fields of medicine and pharmacology. It was found that the hydrogels based on the amino acid L-Cys, silver nitrate and chloride or bromide anions can be obtained by direct mixing of all the initial components [1]. The aim of this work is to study the kinetics of gelation in three-component systems based on L-Cys and silver nitrate, in which metal halides (Cl^- or Br^-) are used as the gelation initiator.

The molar ratio of the initial components ($\text{Ag}^+/\text{L-Cys}$) varied from 1.33 to 2.00, the L-Cys concentration in the samples was 1.5 or 3.0 mM, the metal halides content was varied from 0.25 to 1.5 mM.

The strength of the hydrogels was estimated by a five-point scale [2] by the character of the deformation of the gel sample in the test tube, when it was turned over 180 degrees. This allowed us to determine the optimal composition of the gel systems with maximum strength and stability over time. In addition to strength, an important characteristic of the hydrogels is their stability over time. It is found out that the L-Cys- AgNO_3 based hydrogels with chloride or bromide anions keep their properties such as transparency, homogeneous state, thixotropic properties (the ability to repeatedly restore its structure after mechanical stress) for a long time - from 2 weeks till two months.

The kinetics of the formation of the spatial gel network in L-Cys- AgNO_3 based samples with different contents of Cl^- or Br^- and silver ions was studied by viscosity measurements. It should be noted that viscosity, gelation time, thixotropic behavior of the hydrogels with chloride and bromide anions are different. The kinetics of gelation in L-Cys- AgNO_3 samples was studied also by means of UV spectroscopy and dynamic light scattering (DLS) techniques.

The DLS results showed that the radius of the aggregates formed in the systems depends on time and mainly on the concentration of all components. It is established that particle size distributions for each of the studied systems are variable. In the electronic spectra of the samples with Cl^- or Br^- , there are significant differences that can be explained by the features of the supramolecular chains consisting of silver mercaptide molecules and halide anions. Scanning electron microscopy confirmed various of the structure of the samples containing chloride and bromide anions.

The work is performed under financial support of the Ministry of Education and Science of the Russian Federation in the frame of realizing of the State task in the field of the scientific activity (project N4.5508.2017/BP).

This work is performed by means of the Equipment Center for collective Use of Tver State University.

References:

1. Ovchinnikov M.M., Laguseva V.S., Khizhnyak S.D., Pakhomov P.M. One-stage gelation of L-cysteine-silver solutions // Vestnik of the Tver State University. Series: Chemistry. – 2017. – Vol. 4, No. 4 – P. 135–145.
2. Khizhnyak S.D., Komarov P.V., Ovchinnikov M.M., Zherenkova L.V., Pakhomov P.M. Mechanism of gelation in low-concentration aqueous solutions of silver nitrate with L-cysteine and its derivatives // Soft Matter. – 2017. – Vol. 30, No. 13 – P. 5168–5184.