The rheological characteristics of the solutions containing nanocluster polyoxometalates and polyvinylpyrrolidone

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Spherical nanocluster polyoxometalates based on molybdenum attract the attention by the uniqueness of the structure and the ease of synthesis. They are promising as sorbents, catalysts for fine organic synthesis. Due to the presence of internal cavities and pores on the surface different substances, including drugs can enter inside nanoclusters. It makes them prospective from the point of view of creation of nanocapsules for targeted drug delivery into the body. We found that the nanoclusters are able to stabilize polymers under ultraviolet and X-ray irradiation.

We continued the study of the interaction of nanoclusters with polymers. The effect of nanoclusters on the kinematic viscosity of polyvinylpyrrolidone solution was investigated for

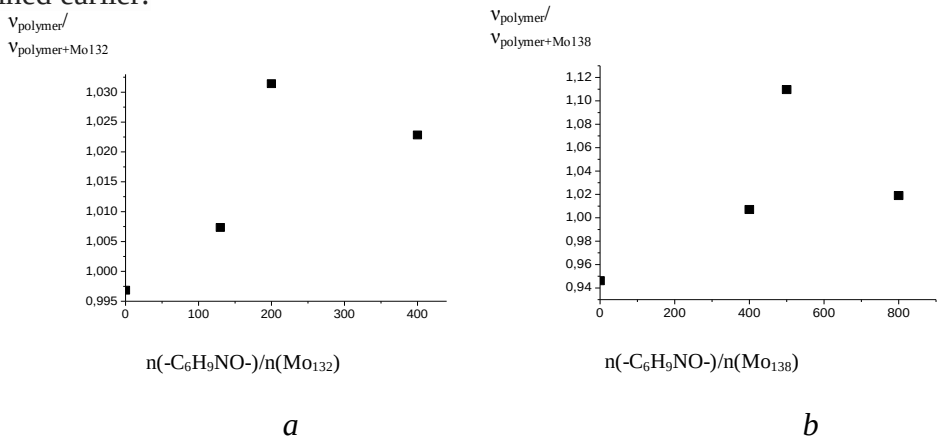
$(NH_4)_{42}[Mo^{VI}_{72}Mo^{V}_{60}O_{372}(CH_3COO)_{30}(H_2O)_{72}]\cdot 300H_2O\cdot 10CH_3COONH_4$ (Mo_{132}),

$(NH_4)_{32}[Mo^{VI}_{110}Mo^{V}_{28}O_{416}H_6(H_2O)_{58}(CH_3CO_2)_6]\cdot xH_2O$ (x~250) (Mo_{138}),

$[Mo_{72}Fe_{30}O_{252}(CH_3COO)_{12}\{Mo_2O_7(H_2O)\}_2\{H_2Mo_2O_8(H_2O)\}(H_2O)_{91}]$~$150H_2O$ ($Mo_{72}Fe_{30}$).

The experimental results showed that the introduction of nanoclusters into the solution of polyvinylpyrrolidone reduces the viscosity of the system. The decrease in viscosity indicates the presence of interaction between components, partial bonding of the active centers of the polymer, which prevents the interaction of polymer molecules with each other. Additional measurements of viscosity for aqueous solutions of polyvinylpyrrolidone with Mo_{132} were performed after 7 days. In specified conditions nanoclusters were not decomposed. The resulting viscosity was less than that of freshly prepared solutions. It indicated the duration of processes in solutions.

The relationship of rheological properties of the studied solutions with the processes of interaction between polymer macromolecules and ions of polyoxometalates was also confirmed by the following calculations. For the solutions of polyvinylpyrrolidone with Mo132 and Mo138 the dependence of the ratio of the pure polymer viscosity and its viscosity in the presence of polyoxometalate was derived. The curves illustrating such dependencies (Figure) had a maximum in the region corresponding to the ratio of the components in nanocluster-polyvinylpyrrolidon associates defined earlier.



a *b*

Fig. Dependence of the ratio of pure polymer aqueous solutions viscosity per viscosity of nanoclusters in polyvinylpyrrolidone solution on the number of monomer units per nanocluster: *a* – Mo_{132}, *b* – Mo_{138}, concentration of nanoclusters $4.5\cdot10^{-4}$ mol/l, 25 °C