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## DYNAMICS OF SILVER NANOPARTICLES FORMATION IN COLLOIDAL SYSTEM AND POLYMER MATRIX

Polymer composites containing Ag nanoparticles (NPs) are of special interest for obtaining new nanostructural materials and creation of devices on their basis, thanks to the unique properties of Ag NPs. In spite of a large number of works in this area, the dynamics of Ag NPs formation in a colloidal system and a polymer matrix at UV radiation and acoustochemical influence is not sufficiently studied. The purpose of present work is to determine the influence on the Ag NPs size and dynamics of their formation of such factors as UV irradiation and ultra-sound (US) treatment and also the concentration of polyvinyl alcohol (PVA) – stabilizer and reducing agent for Ag particles.

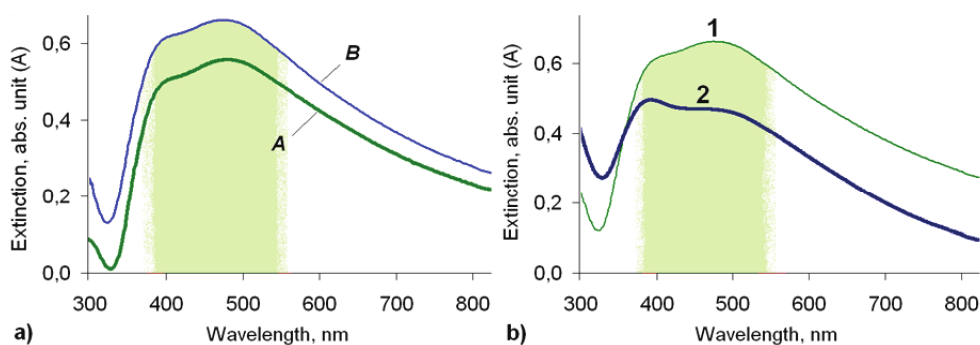


Fig. 1 – Extinction spectra of PVA compositions with Ag particles.  
 a) after: **A** – US treatment and UV irradiation ( $\lambda_{\max} = 470$  nm), **B** – repeated US treatment;  
 b) in 2 days: **1** – sample after US and UV treatment ( $\lambda_{\max} = 474$  nm), **2** – sample without US and UV treatment. Reduction of  $\text{Ag}^+$  occurs only due to PVA matrix,  $\lambda_{\max} = 395$  nm and  $\lambda_{\max} = 470$  nm.

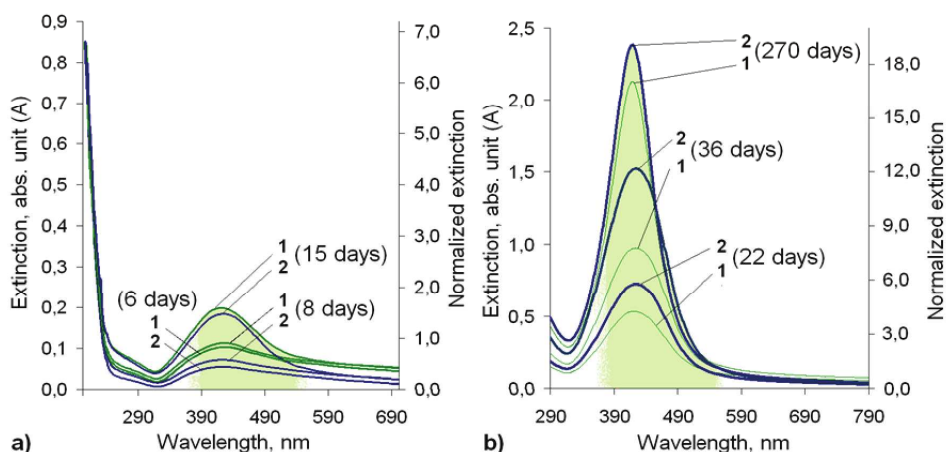


Fig. 2 – Extinction spectra of PVA films with Ag particles in 6, 8, 15 days (a) and 22, 36, 270 days (b).  
**1** – PVA film after US and UV treatment, **2** – PVA film without treatment. Right scale – normalized extinction, magnification by 8 times.  $\lambda_{\max} = 424$  nm (6-36 days),  $\lambda_{\max} = 419$  nm (270 days).  
 Average size of Ag NPs in 270 days – 35 nm. There is growth of SPR absorption after film formation.

Using spectroscopy in the UV and visible regions of the spectrum, atomic force microscopy and the method of dynamic light scattering, the growth dynamics and the size distribution of Ag particles in the PVA composition, PVA film and aqueous sol were studied. Hypsochromic shift of the surface plasmon absorption band of Ag NPs when changing from the PVA composition to the film has been measured (the magnitude of the shift is 55 nm). The dynamics of Ag particles formation and particle size have been shown to be highly dependent on UV irradiation, ultrasonic action and PVA concentration. Thus, it has been established that UV irradiation accelerates Ag NPs formation in the presence of reducing agents and destroys the formed nanoparticles at a lack of reductant. Partial destruction of Ag NPs occurs under the influence of ultrasound only, while after UV irradiation ultrasound action leads to the reduction of Ag ions on the clusters.

#### REFERENCES

1. Potapov, A. L., Daineko, O. A., Ivanova, N. A., Agabekov, V. E., and Bin-Hussain, M., "Formation and properties of films based on polyvinyl alcohol and doped with silver nanoparticles", *Appl. Surf. Sci.*, 2015, vol. 350, pp. 121–128.