

SYNTHESIS IN PICKERING EMULSIONS OF BISMUTH-CONTAINING SORBENTS

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The use of nanobiotechnologies for creating sorption materials for the treatment of wound infections is aimed at overcoming the antibiotic resistance of microorganisms. In this connection, sorption materials, contained an agent endowed with their own antibacterial activity, are in demand [1]. Bismuth (Bi) and its compounds are the most promising antibacterial agents. Moreover, Bi belongs to the "green" elements and widely used in medicine [2]. By introducing Bi nanoparticles (Bi-NPs) in the sorbent matrices and exploiting its specific properties, it is possible to achieve the necessary therapeutic effects of new composite sorbent materials.

In order to preserve the functionality of lipophilic Bi-NPs, previously a method for their synthesis in the medium of the β -cyclodextrin with polyvinylpyrrolidone (β -CD-PVP) stabilizing system in the process of redox reaction of bismuth nitrate with sodium borohydride was developed. β -CD was chosen as a stabilizer since its presence in the sorbent matrix will allow to improve the sorption efficiency due to β -CD is able to form inclusive "guest-host" complexes with biologically active substances [3].

Using UV- and visible spectroscopy and dynamic light scattering, it was shown the formation of Bi- β -CD-PVP ternary complexes. By varying the concentration ratio of β -CD / PVP (wt% / wt%), the optimal conditions for the formation of the most stable complexes were determined at β -CD / PVP = 10 / 90 and 90 / 10. Depending on the β -CD / PVP, the stabilization on Bi-NPs occurred by different mechanisms. The steric stabilization with the distribution of PVP molecules on the surface of nanoparticles was occurred at β -CD / PVP = 10 / 90; the inclusion of nanoparticles in the hydrophobic cavities of oligosaccharide molecules was occurred at β -CD / PVP = 90 / 10 (Fig. 1).

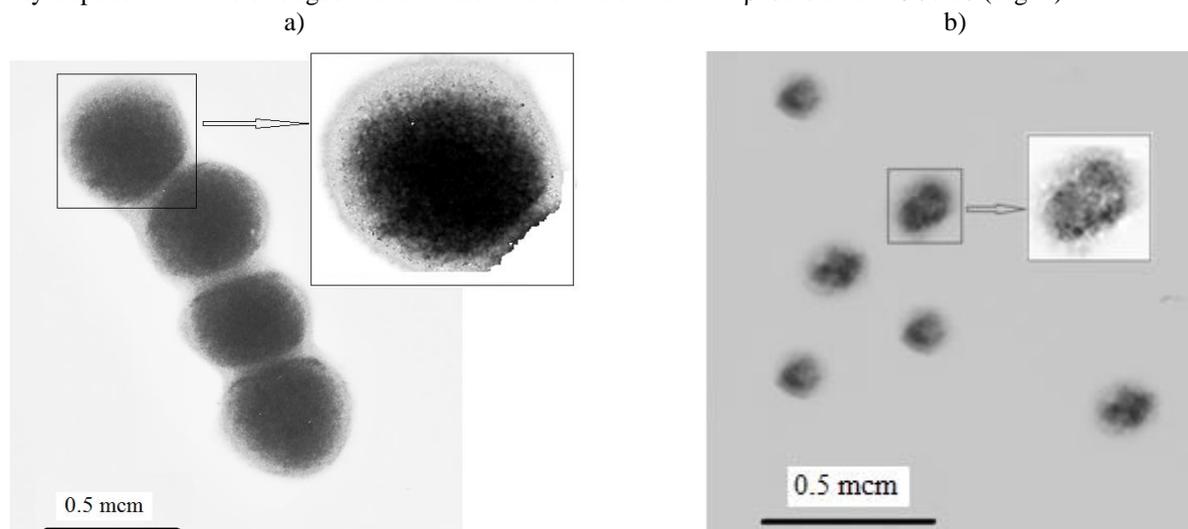


Fig. 1. The Bi- β -CD-PVP complexes synthesized at β -CD / PVP = 10 / 90 (a) and at β -CD / PVP = 10 / 90 90 / 10 wt% / wt%.

For the synthesis of hybrid organic-inorganic sorbents, a method of radical copolymerization in Pickering emulsions of such monomers as methacrylic acid, hydroxyethyl methacrylate, ethylene glycol dimethacrylate was developed. Both simple (oil / water) and complex (oil / water / oil) Pickering emulsions were formed directly in colloidal solution of the Bi- β -CD-PVP complexes. The radical copolymerization of monomers proceeded in aqueous medium in which stabilization of the emulsion phases was carried out with an excess of the Bi- β -CD-PVP complexes. At the same time, the complexes were covalently attached in the polymer matrix. IR spectroscopy showed the presence of β -CD ligand and X-ray analysis showed the presence of Bi and bismuth oxide in the hybrid matrices.

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