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TERNARY COMPLEX POLYCATION/POLYANION/Ag_2O AS A PROMISING MATERIAL FOR CREATING COATINGS WITH DUAL BIOCIDAL ACTION

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The use of low molecular weight biocides for the treatment of premises with high sanitary standards has significant disadvantages associated with the durability of such coatings, as well as the increasing resistance of bacteria. Biocidal compositions based on interpolyelectrolyte complexes (IPEC) are of potential interest for practical use, since they contain regions with free charged cationic groups that can provide both a biocidal effect and adhesion to hydrophilic surfaces. Also, the hydrophobic regions of IPEC can improve adhesion to hydrophobic surfaces, as well as modify such systems with low molecular weight bioactive compounds, for example, silver oxide Ag_2O, which has widely proven itself as a biocide. Such a system will have increased durability along with a dual biocidal action. The decisive advantages of such ternary systems are increased wear resistance along with a dual biocidal action. In this work, we studied the formation and properties of water-soluble IPECs based on pH-independent polydiallyldimethylammonium chloride (PDADMAC), whose biocidal properties are widely known, and sodium polystyrenesulfonate (PSS). IPEC was also modified by incorporating Ag_2O nanoparticles to obtain a ternary composite PDADMAC/PSS/Ag_2O.

The interaction of PDADMAC with PSS was studied by turbidimetric titration of a PDAMAC solution. It has been established that water-soluble IPECs can be obtained at ratios of anionic and cationic groups in the composition of polymers χ = [PSS]/[PDADMAC] up to a critical value of 0.16. The phase separation in solutions of water-soluble IPECs with was studied in presence of simple salts with mono- and bi-valent ions. It has been established that all studied complexes are resistant to phase separation in a wide range of ionic strengths of solutions.

The inclusion of silver oxide nanoparticles into the complex was carried out by ultrasonic dispersion (UD) of a coarse-grained powder in an IPEC solution. The means size of the resulting particles was estimated using the method of transmission electron microscopy and was found to be 5-6 nm. The particles were demonstrated to retain their size during long time period after preparation by UD.

The aggregative stability of PDADMAC/PSS/Ag_2O in solution was evaluated using spectrophotometry and dynamic light scattering. The system was demonstrated to have sufficient colloidal stability.

The biocidal properties of PDADMAC, its complex with PSS, and the PDADMAC/PSS/Ag_2O system was studied by microbiology methods. The complexation with PSS did not affect the antibacterial effectiveness of the PDADMAC, while the formation of ternary complexes with Ag_2O resulted in increase of antimicrobial activity.

Thus, taking into account the high antibacterial activity and aggregative stability, ternary systems based on IPEC and silver oxide nanoparticles are a promising material for use as antibacterial coatings.

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CARBOXYMETHYL CYCLODEXTRIN ENSEMBLES ON CATIONIC LIPOSOMES AS CAPACIOUS NANOCONTAINERS FOR HYDROPHOBIC MOLECULES

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Liposomes are spherical bilayer lipid vesicles that have long of utilization as nanocontainers in drug delivery. However, the capacity of such nanocontainers towards hydrophobic molecules is small and rarely exceeds several percent. To solve this problem, a method has been proposed in this work to modify the liposome surface with molecules with additional affinity to hydrophobic compounds.

Carboxymethy lcyclodextrins (CMCDs) are small biocompatible cyclic polysaccharides with sizes less than 1 nm. Internal structure The CMCD cavities allow the formation of "guest-host" complexes with aromatic fragments of bioactive molecules. Modification of the liposome surface using CMCDs can significantly improve the capacity of the liposomal nanocontainer with respect to hydrophobic molecules.

As a central core for the adsorption of CMCD, we propose to use liposomes formed from a mixture of the electroneutral lipid dioleoylphosphatidylcholine and the cationic lipid dioleoyl trimethylammonium propane (DOTAP) with the molar fraction of DOTAP 0.3. While the carboxyl groups of CMCD provide electrostatic adsorption on the surface a lipid bilayer containing cationic groups, additional stabilization of complexes can be achieved due to hydrophobic interactions of CMCD with the lipid bilayer. The interaction of liposomes with CMCDs and the compositions of the resulted complexes were studied using laser microelectrophoresis, dynamic light scattering, conductometry, IR-scpectroscopy and Langmuir-Blodgett techniques. The ability of complex nanocontainers to incorporate hydrophobic molecules was studied using UV-Vis spectrophotometry. As model bioactive molecules the phenolphthalein and curcumin were studied. Nanocontainers were visualized using atomic force microscopy. It has been established, that cationic liposomes can accumulate on their surface several hundred CMCD molecules, and an increase in the size of the liposome leads to an increase in the maximum possible number of CMCD molecules. It is important to emphasize that colloid-stable systems can be formed using different ratios of CMCD and DOTAP molecules in a wide range. It has been demonstrated that cationic liposomes modified by CMCD are capable of including hydrophobic molecules of bioactive compounds in an amount about 10 times exceeding the capacity of individual liposomes for these compounds

The cytotoxicity of the formed nanocontainers was studied by MTT test with the following results. The positively charged complexes of CMCDs and cationic liposomes as well as complexes with curcumin demonstrated high cell viability in wide range of concentrations up to 2 mg/ml.

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