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Ag nanoparticle-based nanocomposites with non-fouling and antibacterial properties

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Silver compounds are well-known antimicrobial agents and they are widely used in biomedical applications including fabrication of bandages, catheters, implants etc. Deposition of nanocomposite Ag/plasma polymer thin films has been acknowledged as a versatile tool for the modification of surfaces of medical instruments and it has been extensively studied. In particular, Ag/poly(ethylene oxide) plasma polymers (ppPEO) have been successively prepared by sputtering of silver in an atmosphere of ether-bearing precursors. The motivation was to broaden the functionality of the films by combining the bactericidal properties of Ag with the non-fouling properties of PEO. In this case, the process of the plasma polymer growth was coupled with the formation of Ag inclusions and it was not possible to control independently the size/amount of the Ag nanoparticles (NPs) and the properties of the polymeric matrix. In the presented work, we aimed at overcoming this issue. The Ag NPs with the mean size of 11±3 nm were produced by a gas aggregation cluster source (GAS) whereas the ppPEO was fabricated by an independently controlled process of plasma-assisted vapor phase deposition. Both simultaneous co-deposition and sequential depositions of Ag NPs and ppPEO were tested. The NP flux, the evaporation rate of PEO and the discharge power were three independent variables that allowed fabrication of the films with independently controlled amount of the NPs and chemical composition/crosslink density of the plasma polymer phase. The deposition parameters were optimized to produce the ppPEO with more than 65% retention of the C-O-C groups. Significant reduction of bovine serum albumin (BSA, 50 ug/mL solution in PBS) adsorption was verified and antibacterial effects of these coatings were tested.
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