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Antimicrobial Ag/a-C:H nanocomposite coated titanium substrates for implant applications

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Bacterial infections associated with titanium implants remain a common problem in the orthopedic field. To overcome this, antibacterial plasma polymer nanocomposites have been studied for years due to their antibacterial potency. Unfortunately, the application of these nanocomposites is often hindered by the fact that they are soft and not mechanically stable. Therefore, a hard plasma polymer layer is crucial that can withstand wear abrasion and at the same time shows antibacterial potency2. In this study, a low-pressure plasma-based method was employed for the deposition of hard polymeric nanocomposite coatings containing Ag nanoparticles (AgNPs) on Ti substrates. This method uses a gas aggregation source (GAS) for the formation and deposition of Ag nanoparticles and combines it with plasma enhanced chemical vapor deposition of an amorphous hydrocarbon matrix (a-C:H) that is deposited in a mixture of Ar and n-hexane on substrates placed on a powered RF electrode. The matrix properties can be modified by adapting the applied RF power while the amount of incorporated Ag nanoparticles can be altered by the operational parameters of the GAS. The focus of this study is to deposit an a-C:H matrix containing Ag nanoparticles on Ti substrates and to optimize the working parameters to achieve a mechanically stable coating possessing anti-bacterial properties.UV-Vis spectroscopy was employed to characterize the Ag nanoparticle deposition efficiency at different operational parameters of the GAS. The morphology and chemical composition of different nanocomposite films were studied with SEM-EDS and XPS. Additionally, the antibacterial performance and the Ag ion release rate of the differently prepared samples were investigated. In this way, optimization of the coating deposition process resulting into hard coatings with a prolonged antibacterial efficiency will be achieved.

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