

Antibacterial Effect of Au Implantation in Ductile Nanocomposite Multilayer (TiAlSiY)N/CrN Coatings(Article)

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Просмотр дополнительных организаций

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A multilayered nanocomposite designed for biomedical applications based on (TiAlSiY)N/CrN coating implanted by heavy Au- ions is studied. Ion irradiation produced formation in the upper-surface of local amorphous clusters. The obtained composite system was characterized by SEM-EDS, RBS, SIMS, HRTEM, STEM, and nanoindentation mechanical tests, inspecting microstructure, phase state, elemental composition and surface defectiveness. The range of ion impact with correlation to TRIM simulations amounted to 23.5 nm with visible dislocations and interstitial loops indicating the nanopores' creation up/lengthways to the interface boundary. Mechanical parameters remain stable with a slight decrease (less than 2%) in hardness along with an increase in ductility. The antibacterial effect was evaluated in vitro by agar-diffusion and time-kill (72 h) assessments to define both cell-killing mechanisms: dry surface-contact and cytotoxic golden ions-release into moist environment. The identified antibacterial activity within implantation was 2-2.5 times higher due to inhibition zone diameter and antibacterial rate increase. The Au- implanted composite exhibits excellent defense against Gram-negative and Gram-positive bacteria without appreciable surface contamination. Possible biophysical and chemical mechanisms of microorganisms' disruption and annihilation were proposed and analyzed. The present study shows that produced composite has large potential for use in biomedical areas. Copyright © 2019 American Chemical Society.