Multifunctional Bioactive Nanostructured Films for Metallic and Polymer Implants

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A new approach to design perspective multifunctional bioactive nanostructured films (MuBiNaFs) for metallic and polymer implants is described. MuBiNaFs were deposited by magnetron sputtering and ion implantation assisted magnetron sputtering of composite targets TiC1.5+X and (Ti,Ta)C+X {where X=CaO, TiO2, ZrO2, Si3N4, Ca3(PO4)2, and Ca10(PO4)6(OH)2}. The film morphology, grain size, texture, surface roughness, and phase composition were examined using a combination of various microanalytical techniques. The films were characterized in terms of their adhesion to various substrates, hardness, elastic modulus, elastic recovery, fatigue, wettability, surface charge, electrochemical characteristics, friction and wear in air, under physiological solution and Dulbecko modified Eagle medium with Fetal calf serum. The biocompatibility and bioactivity of the films were evaluated by both in vitro and in vivo experiments. For metallic implants with MuBiNaFs, two groups of in vivo investigations using calvarian and hip defect models were fulfilled. Tephlon plates with MuBiNaFs where studied in vivo using subcutaneous model. In addition, polymer fibres, 15% porosity, with MuBiNaFs were implanted in the rat hip defect and hybrid implants [stem cells from rabbit adipose tissue/MuBiNaFs/PTFE porous membrane] were implanted in the rabbit calvarian defect. The results obtained show that MuBiNaFs possess a combination of high hardness, adhesion and fatigue strength, reduced Young's modulus, low wear and friction, high corrosion resistance with high level of biocompatibility, bioactivity, and biostability that makes MuBiNaFs promising candidates as protective films on the surface of metallic and polymer implants.

Keywords
Biological films
Magnetron sputtering
Composite targets
Structure
Properties