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Modelling of Diamond-like Carbon Film by Double Beam Ion Beam Assisted Deposition

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ABSTRACT

Diamond-Like Carbon (DLC) [1] is an amorphous hard carbon. DLC is frequently used for manufacturing protective thin films because of its chemical inertness, mechanical hardness. We create DLC coating by using the Double-Beam Ion Beam Assisted Deposition (DB IBAD) method on a titanium surface as a substrate. The aim of our numerical simulation is to analyze structure of a film by adjusting mainly energy of both beams. Using DB-IBAD technique we utilize two beams. The first beam (auxiliary) is used to sputter carbon particles from target. The aim of the second beam (primary) is to improve adhesion of the thin film by direct interaction with atoms to be deposited. The process is fully controlled by process critical parameters such as: the energy of both beams, the angle of ion beams to surface, the ratio of deposited atoms quantity to ions in the primary beam, and average energy transferred to the surface.

Computer simulations are bridging microscopic phenomena, i.e. intermolecular potential with macroscopic measures related to phases, structure, and dynamics of plasma fluid. They are also linking the real system of complex fluid with the model system of complex fluid.

The physical-mathematical-numerical (PMN) model is developed to evaluate the sputtering ratio and the structure of thin film following the solution of the rate equations. The solution obtained for the PMN can be verified by the Micro Raman Spectroscopy (MRS) to evaluate the elemental composition. The Rutherford Backscattering Spectroscopy (RBS) and the Secondary Ion Mass Spectroscopy (SIMS) are applied to analyze the atom concentration through the substrate depth. The surface morphology is analyzed by using the Scanning Electron Microscopy (SEM).

Our medical implants are processed by the CNC nano-coating machine where the process critical parameters are adjusted by using data bases that consists of data acquired from experimental measurements done in our laboratory and results of numerical simulations conducted by one of two numerical techniques: KMC-MD, and Rate Equations.

REFERENCES

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