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SURFACE MODIFICATION USING A-C:H:SIO$_X$ FILMS

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One type of diamond-like carbon materials is a-C:H:SiO_x coatings, also called diamond-like nanocomposites (DLN), SiO_x-doped DLC. Such coatings have low internal stresses (less than 1 GPa), hardness in the range of 10÷20 GPa, low friction coefficient and low wear rate [1-3]. Due to the presence of silicon and its compounds (SiO_x) in the structure, the biocompatibility of a-C:H:SiO_x coatings with the human biological environment is improved [4].

The plasma-assisted chemical vapor deposition in a mixture of argon and polyphenylmethylsiloxyloxane vapors was used for coating deposition. The method is described in detail in our previous works [5, 6]. Titanium alloy (Ti-6Al-4V) and stainless steel AISI 316L samples were used as substrates.

It has been shown that deposition of a-C:H:SiO_x coatings leads to improvement of mechanical and tribological properties of materials surface. In particular, after deposition of a-C:H:SiO_x coatings on titanium, titanium alloys and stainless steel its surface hardness increases more than 2-4 times, friction coefficient decreases more than 6 times, and wear rate decreases by two orders of magnitude [7, 8].

It has been established that a-C:H:SiO_x films had low thrombogenicity and are not cytotoxicity for mononuclear leukocytes of human blood (hBMNCs). In addition, a-C:H:SiO_x film leads to decreased concentrations of the proinflammatory cytokines IL-17 and TNF-a as well as the chemokines IL-8, RANTES, MCP-1 (MCAF) in 24-h in vitro culture of hBMNCs. This suggests a potential anti-inflammatory effect of the studied coating and the possibility of its medical application in the field of cardiovascular surgery. The dependence of the concentration of proinflammatory cytokines and chemokines on the a-C:H:SiO_x film thickness correlating with the surface wettability and electrostatic surface potential was established. It was shown that a-C:H:SiO_x film deposition contributed to increasing the corrosion resistance of Ti-6Al-4V samples in 0.5M NaCl and PBS solutions (corrosion rate decreased up to 10^{-6} mm/year). The results of 5-week biodegradation in 0.9% sodium chloride solution demonstrated minimal salt deposition on the surface of samples coated a-C:H:SiO_x film.

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