Assessment of doctoral thesis

"Plasma polymerization in biomedical applications"

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The doctoral thesis is aimed at plasma polymerization as a technique that could be used to deposit materials in a form of thin films with application potential in biomedicine. Carbon based films of plasma-polymerized hexane containing small titanium grains, and thus forming nanocomposite structures, were deposited using DC magnetron sputtering of titanium target in argon and hexane gas mixtures. Another part of the thesis was devoted to surface modifications of polypropylene foils in order to improve their wettabilty using DC discharge in oxygen gas or water vapor.

The deposition and analyses of biocompatible thin films and modified surfaces belong among current topics with high application impact. Nanocomposite thin films are very interesting materials, which are intensively investigated, not only for biological applications.

Plasma species were analyzed using optical emission spectroscopy (OES) and mass spectrometry (MS). The deposited films were extensively characterized by X-ray photoelectron spectroscopy (XPS), Rutherford back-scattering spectroscopy (RBS), and elastic recoil detection analysis (ERDA) with respect to the surface and bulk elemental composition, next by scanning probe microscopy (SPM) and contact angle measurements to analyze surface properties, and transmission electron spectroscopy (TEM) was employed to analyze structure of nanocomposite films. Biological response of nanocomposite coatings was tested to evaluate cell adhesion, their growth and differentiation.

The thesis was well organized, of good graphic design, without significant formal mistakes, and 146 references used gave evidence about good research background. I can state that suitable methods for characterization of plasma species, deposited films, biological materials, and the technological procedures were employed, and they provided relevant information about studied phenomena. First of all, the results on interaction between nanocomposite films and biological materials are very worthful.

Questions and comments are as follows:

- Page.13, Table 1-1: Is really the sp^3 content for soft a-C:H films lower than that for hard a-C:H films?
- Page 24, line 1: "Flow rate was 50 cm/s ..." The unit of flow rate is not correct. What did you measure? You should use cm^3/s for the volume flow rate or sccm for the mass flow rate.
- Page 29, Eq. 2.3: The storage modulus, G', instead of the loss modulus, G'', should be used in the equation.
- Page 44: According to the Fig. 3-7 and Table 3-2, some samples were prepared for FTIR analyses. Why FTIR spectra were not used for characterization of deposited films in the

thesis?

- Page 50, Fig. 3-9: How can you explain a decrease of TiC component (455.2 nm) at the highest hexane flow rate of 1.2%?
- Structure analyses of deposited films could give important results using diffraction techniques (i.e., XRD). Can you expect TiC or TiO_2 phases to be amorphous or do they form crystallites?
- Page 52, Table 3-4: The film deposited in pure Ar contained significantly higher concentration of Ti in comparison with O and C concentrations. However, the film (sample T227) deposited at the same conditions was dominated by oxygen concentration, see Table 3-3. Does it mean that the elemental composition at surface of the film is different from the bulk?
- Page 65, Fig. 3-22: The fibrinogen structure is not visible well using KFM. Would it be possible that an increased potential of immersed part of the sample resulted from application of solutions used (phosphate buffer saline, Mill-Q water)?

The doctoral thesis fulfils the criteria for such a work, demonstrates the author to be in the frame for research, and thus I recommend the thesis for defense proceedings. I recommend awarding the PhD degree to Andrey Grinevich in case of successful defense.

November 14, 2008

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