11th International Conference
on Advanced Materials
Rio de Janeiro Brazil
September 20 - 25
ICAM2009

Study of LbL films of Natural rubber for biomaterials application

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Abstract – Thin films of poly(allylamine hydrochloride) (PAH) and natural rubber (NR) were self-assembled using layer-by-layer (LbL) technique. The NR was used due its ability to promote healing processes [1,2]. The sequential deposition of multilayers was carried out by immersing the substrates alternately into the polycationic PAH solution for 3 min and in the anionic NR latex for 5 min onto a quartz substrate. The growth of the multilayers was monitored using UV-VIS spectroscopy. We evaluated the biological activity of PAH/NR films over the proliferation of normal human fibroblast (NHF) cells by MTT essay. The physical characterization was performed by AFM, SEM and contact angle measurements.

The main goal of this work was to build a thin polymeric coating that can be applied onto implantable devices. The LbL technique is based on electrostatic attraction of opposite charged molecules, which are gradually assembled onto a substrate. The substrate must be immersed on polyelectrolyte solution to obtain a material layer. The films are built by alternated immersion on positively and negatively charged solution [3,4]. Herein we used natural rubber latex that is a colloidal substance with negative charges in pH 10 and can be well deposited over PAH positive molecules. The PAH/NR films were linearly mounted with 5 and 15 bilayers and evaluated by AFM and SEM. Furthermore, contact angle measurement was performed on several PAH/NR films formed by one up to 9 layers. In addition, biological activity of the films was evaluated by NHF cells cultivated (DEMEM in 5% CO_2 at 37°C) over the sample film. The NHF cells were counted by MTT essay after 7, 14 and 21 days of cultivation. MEV and AFM results indicate that PAH/NR films have a rough surface which increases with the bilayer growth (figure 1). This effect was also noted by contact angle measurement that increased from 59.4° to 89.8° on the ninth layer (figure 2). These results shown that PAH/NR films are hydrophilic. In addition, they become hydrophobic as enough layer numbers are built. The MTT essay revealed that PAH/NR can accelerate NHF proliferation 117% greater than control on the seventh day; 57% on 14th day and 29% on 21st day (figure 3). Those results show that film bioactivity is sustained up to 3 weeks. The viability for creating cell interactive materials has been demonstrated for these NR macromolecules using the LbL technique. (Acknowledgments: Capes, CNPq, Profa. Dra. Primavera Borelli - USP)

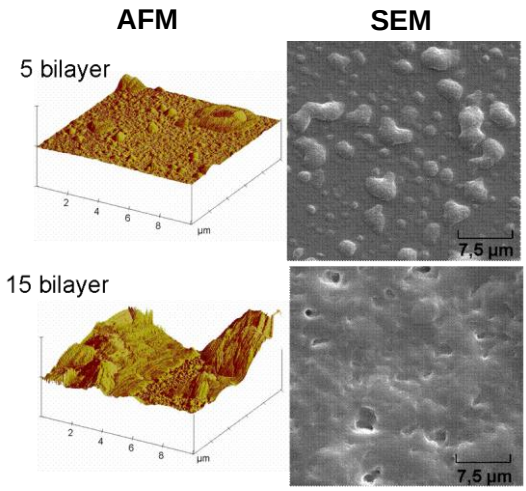

Figure 1: Microscopy analyses of PAH/NR 5 and 15 bilayer films performed by AFM and MEV, respectively.

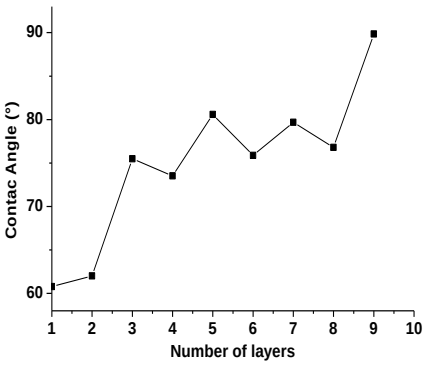

Figure 2: Contact angle measured on PAH/NR films layer by layer. Even numbers had PAH as outmost layer, and odd numbers NR.

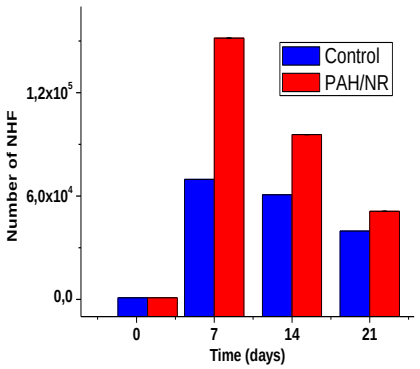

Figure 3: MTT essay results for PAH/NR LbL films.

References

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