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Cytocompatibility studies of raw vertically-aligned multi-walled carbon nanotubes and fuctionalizated by oxygen plasma

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Abstract – We have shown the cytocompatibility of vertically-aligned multi-walled carbon nanotubes films (VACNT) obtained by microwave plasma process (MW) with fibroblast mouse cells and human osteoblast cells. The cytocompatibility tests were performed on raw VACNT and functionalizated by oxygen plasma. The cytocompatibility tests used were: 1) MTT and LDH colorimetric assay methods for viability and proliferation cells studies and 2) cellular adhesion by SEM and fluorescence microscopy. In summary, it was observed high cell viability, exceptional cell adhesion and that super-hydrophilic properties surfaces are generally favorable for adhesion and proliferation of the cells.

The very important role of nanotechnology in the biological scene is becoming clear in the last few years with several papers studying the interaction of VACNT with cell culture for biomaterials application [1-3]. But, the raw aligned VACNT arrays exhibit super-hydrophobic behavior [4], show difficulty in initial times (6-24 hrs) in cellular adhesion, essential for proliferation and differentiation [3]. In this work, we have shown the comparison of cytocompatibility *in vitro* studies between VACNT and functionalizated by oxygen plasma. The VACNT films were obtained by microwave plasma process using Fe and Ni catalysts. After VACNT growth they were submitted to a DC oxygen plasma treatment, during 2 min, at 400 V and 80 mTorr. From this treatment the VACNT converted from superhydrophobic to super hydrophilic. The cells cultures used were L-929 and embryos GFP mouse fibroblasts cells and SaOS-2 human osteoblasts cells. The *in vitro* cytocompatibility tests used were: 1) cytotoxicity, using MTT colorimetric assay to study cell viability, 2) LDH assay based on cellular membrane integrity and 3) cellular adhesion to evaluate the cellular behavior by scanning electron microscopy (SEM) and Fluorescence Microscopy (FM). Characterizations of MWCNT super-hydrophilic surfaces were evaluated by contact angle (CA), Raman spectroscopy and X-Ray Photoelectron Spectroscopy (XPS). The Figure 1 shows the high viability and cellular proliferation of the cells on VACNT. Significant differences on spreading and cell behavior (FEG-SEM, FM) are observed on VACNT super-hydrophilic surfaces (Fig. 2) in initial times (6-24 hours), increasing the number of cytoplasmatic projection in all directions and the number of adhesion focal sites, comparated with raw VACNT surfaces.

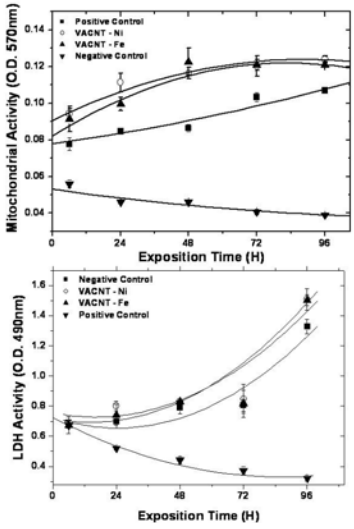

Figure 1: MTT) and LDH activity (LDH total) the VACNT, obtained the Ni and Fe catalisty, after 96 h the exposition.

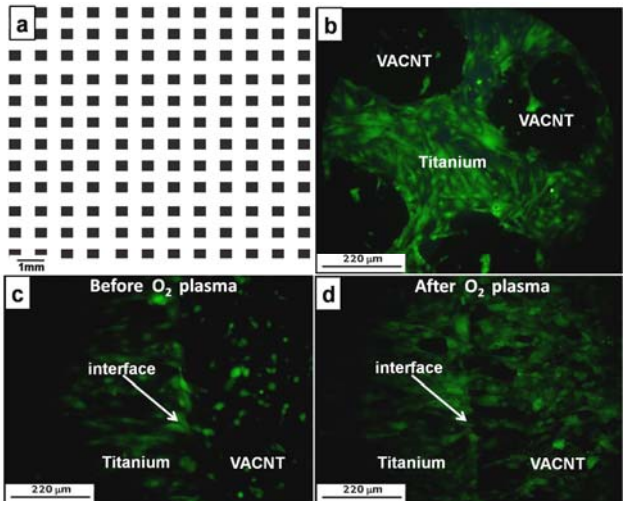

Figure 2: (a)Pattern obtained for conventional lithography to deposite VACNT arrays(b,c e d) Image of FM of MEF-GFP cells on VACNT arrays before plasma treatment, incubated by 48h.

References

[1] S. Giannona, I. Firkowska, J. Rojas-Chapana, et al. *J. Nan. and Nanotec.* 7, 1679 (2007).
[2] A.O. Lobo, E.F. Antunes, A.H.A. Machado, et al. *Mater. Sci. Eng. C* 28(2), 264. (2008).
[3] M. Schindler, I. Ahmed, J. Kamal, A. et. Al. Biomaterials, 26, 5624 (2005).

[4] Z. Wang, N. Koratkar, L. Ci, et al. *Appl. Phys. Lett.,* 90, 143117, (2007).