11th International Conference
on Advanced Materials

Rio de Janeiro Brazil
September 20 - 25

ICAM2009

# Characterization of Novel Hybrids based on Carbon Nanotubes and Polymer Blends for Biomedical Engineering

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**Abstract** – In this study the development and characterization of novel hybrids of polymer blends on chitosan and poly (vinyl alcohol) (PVA) with carbon nanotubes (CNTs) are reported for possible use in a variety of biomedical applications. The hybrid systems were characterized through Fourier Transform Infrared spectroscopy (FTIR). In addition, Synchrotron Small-angle X-ray Scattering (SAXS) technique was used to assess the nanostructure of the hybrid system. The results have clearly revealed the influence of the functionalized carbon nanotubes on the SAXS scattering pattern when compared to those systems without CNTs.

The field of polymer nanocomposites is a rapidly expanding area of research generating new materials with novel properties. Several new materials have been developed within the last decade incorporating nano-sized filler material in polymer matrices. Use of nanomaterials has proven to confer various advantages like improved mechanical, thermal and barrier properties compared to non-filled polymers. These effects are largely due to their high interfacial area, their aspect ratio, their extent of dispersion and percolation. Among several nanomaterials, carbon nanotubes (CNTs) nanotubes have drawn the interest of the research community to be used in biomedical applications, such as tissue engineering. Recent studies with CNTs have emphasized the use of chemically functionalized CNTs to achieve specificity in binding to biological structures. Thus, polymer blends are particularly promising biomaterials as the physical and physiological properties of the polymers can be closely controlled through manipulation of the type and organization of the chemicals groups in the polymer's backbone. Chitosan joined to other polymers opened a window of research for altering or tailoring the property of interest. Blend systems with PVA hydrogel has been explored for medical and pharmaceutical application due to the advantage of non-toxic, non-carcinogenic and bioadhesive properties [1-2].

In the present work, we report the development and characterization of novel hybrids combining polymer blends based on Chitosan and PVA and chemically functionalized CNTs for potential use in bone tissue engineering. Hybrid systems with different proportions of Chitosan and PVA were synthesized and chemically characterized by FTIR (Figure.1). In addition, SAXS technique was used to assess the nanostructure of the hybrid system (Figure 2). The results have clearly revealed the influence of the functionalized carbon nanotubes on the SAXS scattering pattern when compared to those systems without CNTs. The properties have significantly enhanced by adding CNTs to the polymeric blended network. In conclusion, novel hybrids were produced by joining CNTs with biocompatible polymeric blends for potential use in biomedical engineering.

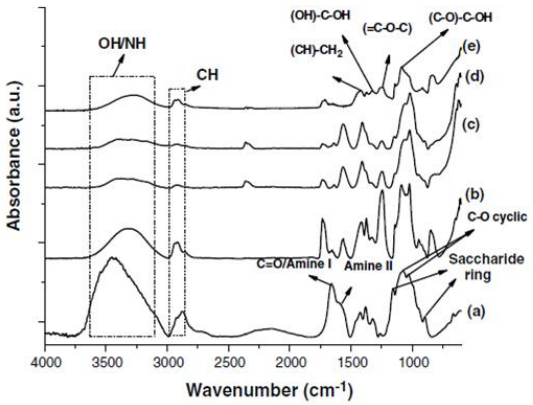


**Figure 1:** FTIR spectra of the chitosan (a), C/P (1:3) (b), C/P (1:1) (c), C/P (3:1) (d) and PVA (e)

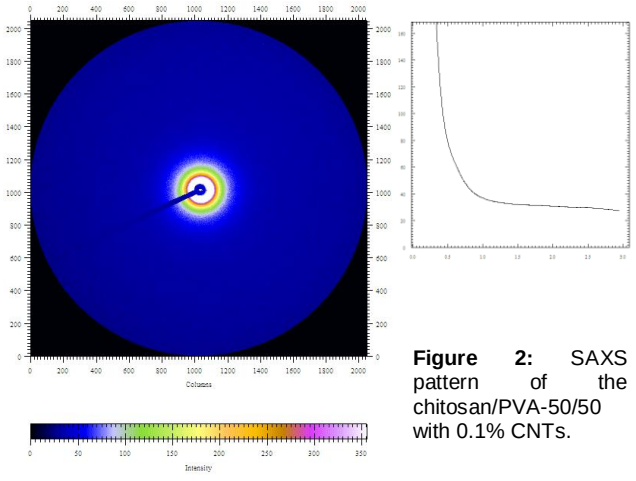

**Figure 2:** SAXS pattern of the chitosan/PVA-50/50 with 0.1% CNTs.

[1] E.S. Costa-Júnior, H. Mansur, Carbohydrate Polymers 76 (2009) p. 472–481.

[2] H. Mansur, H. Costa, Chemical Engineering Journal 137 (2008) p. 72–83.