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Nitrogen Incorporation to MWCNT Produced by Spray-Pyrolysis

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Abstract – In this work is shown the synthesis of MWCNT using spray-pyrolysis techniques. The main goal is to describe nitrogen incorporation levels as function of the amount of dopants in precursor's materials which are combined in different proportions. Analysis includes SEM-FEG images, Raman spectroscopy and XPS.

Electronic and geometric properties of carbon nanotubes are strongly dependent upon the incorporation of dopants and nitrogen is a natural candidate for type n doping. Two important characteristics are stressed. It enhances the tube affinity for ligands and can change the semiconductor character of undoped structures. These are auspicious changes if one is to design CNT sensors.

The point is that it is not easy to incorporate nitrogen since it tends to destroy the regular arrangement of the periodic system. One not needs high doping levels to observe signals of this characteristic in RAMAN analysis.

This work intends to show the increasing of nitrogen incorporation in MWCNT as a function of the nitrogen proportion amount in precursors. Toluene is used as carbon source. Ferrocene is the chosen catalyst and processing temperature and catalyst proportion are investigated as an additional parameter, in order to define the best conditions for MWCNT growth. Acetonitrile and propionitrile as nitrogen sources are studied, considering different proportional mixtures with toluene in feedstock. MWCNT were produced by spray-pyrolysis technique [1,2], investigating the effects of different parameters as temperature (800-950°C), organic compounds precursors, percentage of nitrogen source in precursors (0-100%).

Results obtained from a typical sample are shown in figures (1) and (2),

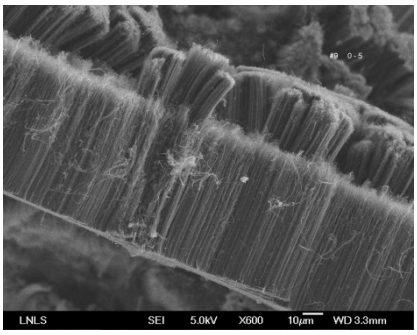

Figure 1: Typical N-doped MWCNT grown using pure acetonitrile.

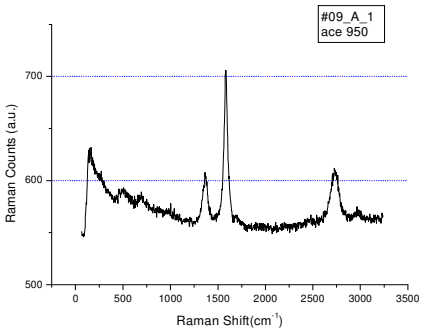

Figure 2: Raman spectra for the same sample shown in figure (1).

This work is completed with a XPS analysis to determine the amount of nitrogen incorporation and chemical environment in samples produced by changing the precursor mixtures.

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References :

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[2] P. Ayala et. al. The Journal of Chemical Physics 127 (2007) 184709.