EFFECT OF MOLYBDENUM ON THE CATALYST SUPPORTED GROWTH OF CARBON NANOTUBES BY THERMAL CHEMICAL VAPOR DEPOSITION

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Carbon nanotubes (CNTs) are promising candidates for applications ranging from nano-electronics, to field emission displays, sensors and electrochemical devices [1,2]. The CNT unique physical properties strongly depend on the CNT structural characteristics (diameter, number of layers, length, presence of defects…). For that reason, a very strict control of the different experimental parameters is required during the CNT production.

The chemical vapor deposition (CVD) technique is a very efficient method for producing CNTs due to its versatility, low cost and scalability.

We have previously reported strategies to efficiently control the CNT diameter in Fe-, Co- and Ni catalyst-supported CVD processes. The influence of molybdenum on the CVD "bulk" production of carbon nanotubes was also recently reported [3]. Herein we show the effect of Mo on the catalyst supported growth of CNTs on quartz substrates substrates.

We here present the production of multi-walled carbon nanotubes (MWNTs) by decomposition of acetylene over Mo-containing catalyst supports at 750-900ºC. Fe-, Co- and Ni containing catalyst solutions were mixed with ammoniumheptamolybdat in different ratios, and then deposited by simple spray-coating on quartz substrates. After appropriate catalyst pretreatment (calcination, reduction, thermal treatment and ammonia gas etching) [4] and by adjusting other experimental parameter such as temperature, [5] acetylene flow and reaction time, MWNTs were efficiently grown. We have observed that the distribution of the catalyst improved with regard to the samples without molybdenum resulting in a dense growth of carbon nanotubes with thinner average diameter.
The catalyst and produced CNTs samples were characterized by SEM, TEM, Raman and XRD.

We are going on with the study of Mo combined with the typical CNTs-growth catalyst towards the controlled synthesis of single-walled carbon nanotubes (SWNTs) on different substrates in similar experimental conditions as the aforementioned.

References:

[1] R. H. Baughman, A. A. Zakhidov, W. A. de Heer, Science, **297** (2002) 787.
[2] H. Dai, Surf. Sci., **500** (2002) 218
[3] M. Peréz-Mendoza, C. Vallés, A. M Benito et al, Nanotechnology, **16** (2005) S224
[4] K. S. Choi, Y. S. Cho, S. Y. Hong et al, J. Eur. Ceram. Soc., **21** (2001) 2095
[5] C. J. Lee, J. Park, Y. Huh et al., Chem. Phys. Lett., **343** (2001) 33.