

Workshop “Nanosciences and Nanotechnologies at the University of Porto – Challenges and Future Needs”
November 18-19, 2005, Porto, Portugal

Carbon Nanotubes and Nanofibers: Long Term Involvement and Recent Applications

J.L. Figueiredo, J.L. Faria, J.J.M. Órfão, M.F. Pereira, H.T. Gomes, M.M.A. Freitas

Laboratório de Catálise e Materiais, Faculdade de Engenharia da Universidade do Porto

Carbon nanotubes (CNTs), carbon nanofibres (or filaments, CNFs) and vapor-grown carbon fibres (VGCFs) are related materials that can be obtained by pyrolysis of hydrocarbons in the presence of suitable catalysts. The common origins of these carbon nanostructures were discussed in a recent NATO ASI [*Carbon Filaments and Nanotubes: Common Origins, Differing Applications?* Eds. L.P.Biró, C.A.Bernardo, G.G.Tibbetts, Ph.Lambin, Kluwer Academic Publishers, Dordrecht, 2001].

CNTs are revolutionary new materials that have unique properties. They can be thought of as rolled graphite tubes, with diameters ranging from 0.8 to 300 nm. They have very high tensile strength and modulus, and can function either as a conductor or as a semi-conductor, depending on their structure. The potential for applications of these materials in the Nanotechnology field is enormous.

At LCM, we have a long time involvement in the area of carbon nanofibers and related nanostructures by catalytic chemical vapor deposition (CCVD). As an example, we will show a short movie (courtesy of Dr. Terry Baker) highlighting the growth of carbon nanofibers using Controlled Atmosphere Electron Microscopy, as well as examples (SEM micrographs) of related materials obtained in our laboratory over the years.

More recently, we have studied the production and characterization of CNTs and CNFs by CCVD in order to: a) identify the operating conditions which favour the formation of each form of tubular carbon (filaments vs nanotubes); b) optimize the production of each type of structure; c) study the application of these materials in catalysis.

The expertise of LCM in this field is a valuable asset that we intend to use in novel projects in this area and in the proposed network on “Nanosciences and Nanotechnologies at the UP”. Some of our most recent publications in these topics are listed below.

RECENT PUBLICATIONS:

M. F. R. Pereira, J. L. Figueiredo, J. J. M. Órfão, P. Serp, P. Kalck, Y.Kihn, “Catalytic Activity of Carbon Nanotubes in the Oxidative Dehydrogenation of Ethylbenzene”, *Carbon*, **42**, 2807-2813 (2004).

H.T. Gomes, Samant P. V., Serp Ph., Kalck Ph., Figueiredo J. L., Faria J. L., Carbon Nanotubes and Xerogels as Supports of Well Dispersed Pt Catalysts for Environmental Applications, *Applied Catalysis B: Environmental*, **54**, 175-182 (2004).

A.Méndez, M.M.A. Freitas, M.C.Schouler, P.Gadelle, J.L.Figueiredo, "Synthesis of carbon nanotubes over different MgO/Fe catalysts", *Carbon'03, An International Conference on Carbon*, Oviedo, Spain, July 2003.

Ph. Serp, R. Feurer, Y.Kihn, Ph. Kalck, J.L. Faria, J.L. Figueiredo, “Controlled growth of platinum nanoparticles on carbon nanotubes or nanospheres by MOCVD in fluidized bed reactor”, *J. Phys.IV France*, **12**, Pr 4-29 – Pr4-36 (2002).

Ph. Serp, R. Feurer, Y.Kihn, Ph. Kalck, J.L. Faria, J.L. Figueiredo, “Novel carbon supported material: highly dispersed platinum particles on carbon nanospheres”, *J.Mater.Chem.*, **11** (8), 1980-1981 (2001).

Ph. Serp, R. Feurer, Ph. Kalck, Y.Kihn, J.L. Faria, J.L. Figueiredo, “A chemical vapour deposition process for the production of carbon nanospheres”, *CARBON*, **39**, 621-626 (2001).

Ph. Serp, R. Feurer, Ph. Kalck, H.T. Gomes, J.L. Faria, J.L. Figueiredo, “A new OMCVD iridium precursor for thin film deposition”, *Chem. Vap. Deposition*, **7**, 59-62 (2001).

J.L.Figueiredo, Ph.Serp, “Optimizing growth conditions for carbon filaments and vapor-grown carbon fibers”, in “Carbon Filaments and Nanotubes: Common Origins, Differing Applications?”, Ed. L.P.Biró, C.A.Bernardo, G.G.Tibbetts, Ph.Lambin, Kluwer Academic Publishers, Dordrecht, pp.111-120, 2001.