Available online at www.sciencedirect.com
SCIENCE DIRECT
ELSEVIER
Journal of Non-Crystalline Solids 352 (2006) 1310–1313
JOURNAL OF NON-CRYSTALLINE SOLIDS
www.elsevier.com/locate/jnoncrysol

Study of CNTs and nanographite grown by thermal CVD using different precursors

S. Porro [a,*], S. Musso [a], M. Giorcelli [a], A. Tagliaferro [a], S.H. Dalal [b], K.B.K. Teo [b], D.A. Jefferson [b], W.I. Milne [b]

[a] *Politecnico of Torino, Physics Department, c.so Duca degli Abruzzi 24, 10129 Torino, Italy*
[b] *Cambridge University Chemical Laboratory, Lensfield Road, Cambridge CB2 1EW, UK*

Available online 29 March 2006

Abstract

Carbon nanotubes (CNTs) are obtained by chemical vapor deposition (CVD) on uncoated silicon and quartz substrates. The process of synthesis involves the co-evaporation of a carbon precursor and a metal catalyst in a nitrogen atmosphere in a high temperature furnace. Beside the formation of CNTs, by varying few parameters, other carbon structures can be deposited, such as a nanographite layer. In particular we believe that our version of thermal CVD is an economic and efficient process in alternative to other methods for the growth of nanographite. The morphology and structure of our samples were characterized by multi-wavelength Micro-Raman spectroscopy, SEM and HR-TEM analyses. We found that our CNTs have an average diameter of 80 nm, with length between few and hundreds of micrometers. Brunauer–Emmett–Teller (BET) analysis was used to calculate the specific surface area and porosity. Furthermore, we have performed an hydrogen storage experiment on our CNTs samples, finding an adsorption capacity of about 1.7 wt%, at 14 bar and 190 °C.

PACS: 81.07.De; 81.15.Gh; 81.05.Uw

Keywords: Chemical vapor deposition; Scanning electron microscopy; TEM/STEM; Nanoclusters; Nanocrystals; Nanoparticles; Raman spectroscopy; Carbon-based and nanotubes; Adsorption

1. Introduction

Since carbon nanotubes (CNTs) were first reported in 1991 [1], they have received a great deal of attention in many research fields because of their unique physical and chemical properties. In particular, due to their high surface and abundant pore volume, they are considered for gas storage, and efforts are aimed to adjust CNTs properties in order to store large amounts of gas at room temperature [2,3]. This interest has been strengthened recently by the discovery of the hydrogen adsorption capacity in carbon nanotubes and other carbon materials (such as nanoporous carbon or nanofibers) [2].

In this work we focus on the development of a thermal CVD method, which does not require pretreated substrates and in principle it is simple and inexpensive, in order to grow massive samples of aligned and well packed carbon nanotubes on different substrates.

We also believe that our version of thermal CVD is an economic and efficient process in alternative to other methods for the growth of nanographite films. Deposition of such films can be achieved by various methods, but these all have drawbacks, including cost and/or the necessity of long and expensive post deposition treatments in order to remove impurities. The most common methods are the mechanical ball milling of pyrolytic graphite in hydrogen atmosphere [4,5], electrophoretic deposition (EPD), heat treatment of diamond nanoparticles on a highly oriented pyrolytic graphite (HOPG) substrate [6], and the arc discharge of SiC in hydrogen atmosphere [7].

* Corresponding author.
E-mail address: samuele.porro@polito.it (S. Porro).

0022-3093/$ - see front matter
doi:10.1016/j.jnoncrysol.2005.08.041