FUNCTIONALIZED SURFACES BASED ON CONDUCTING POLYMERS AND CARBON NANOTUBES FOR GAS SENSING APPLICATIONS

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The high surface area, size, hollow geometry and chemical inertness remarkable properties of CNTs make them attractive for demanding applications in the field of gas sensing. To date studies on possible applications of CNTs have been focused either on individual single-walled carbon nanotubes (SWNTs) as sensitive materials towards O_2, NO_2 and NH_3 [1-4] or on multi-walled carbon nanotubes (MWNTs) mats as NH_3, CO, CO_2 humidity and O_2 gas sensors [5-7]. Nanotube sensors offer significant advantages over conventional metal-oxide-based electrical sensor materials in terms of sensitivity and small sizes needed for miniaturization and construction of massive sensor arrays. Nevertheless, several outstanding issues remain. Firstly, for sensing purposes, it is desirable to reliably obtain devices consisting of semiconductor CNTs operating at room temperature [1,4,8,9]. Secondly, molecular sensing requires strong interactions between a sensor material and target molecules. This is also the case for nanotubes.

We have reported on the preparation of CNTs thin films by radio frequency plasma enhanced chemical vapor deposition on Si_3N_4/Si substrates, provided with interdigital Pt electrodes, for gas sensing application [8] . From figure 1, it is possible to observe that the nanotubes are aligned perpendicularly to the substrate, as the–pulsed plasma technique well allows. The tubular structure of the nanotubes was verified using TEM microscopy, as shown in figure 2.
We have found that nanotubes are not sensitive to many types of molecules (i. e. CO, H_2, HCl), indicating an apparent lack of specific interactions between nanotube and these molecules. We believe that nanotube sensors with molecular specificity can be obtained through rational chemical and/or physical modification of nanotubes. Chemical modification may include sidewall functionalization by desired molecular groups [10] while physical modification may involve simple deposition of suitable species on the nanotubes, i.e. conducting polymers.

Here, we present recent results in tackling the issues above. Taking into account these materials, the present work focuses on the synthesis of conducting polymer (CP) and a nanocomposite based on CP and MWNTs to study the effective enhancement of CP conducting properties containing CNTs inside the polymeric matrix with respect to the pure polymer, and the fabrication of CNTs thin films and covered with CP for the detection of inorganic vapours.

References:

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Figures:

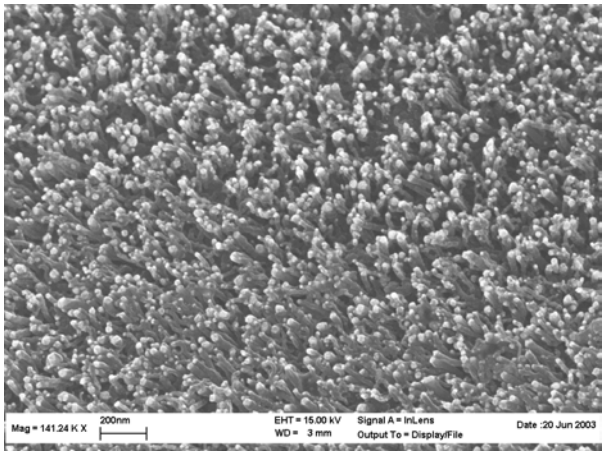

Figure 1: High resolution SEM images of aligned CNTs.

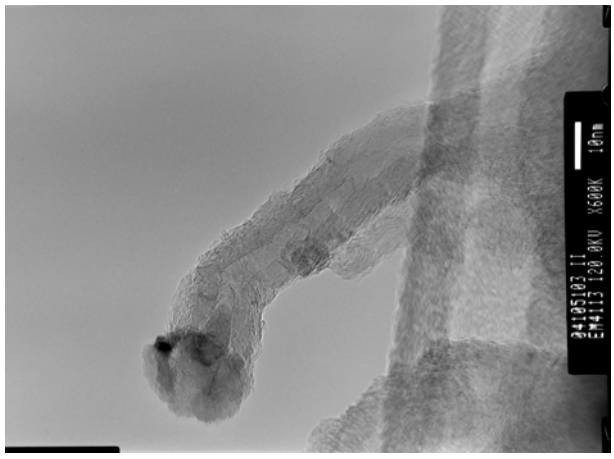

Figure 2: TEM micrograph of CNTs, obtained by plasma pulsed.