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# Carbon-nanostructures/cadmium-sulphide Hybrid Heterostructures Formation

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**Abstract** – We present a low cost method for preparing heterostructures based on cadmiun sulfide (CdS) thin films modified by adding carbon nanostructures. For this particular system we have examined the effect of adding a thin film of multiwall carbon nanotubes (MWNTs) or multiwall carbon nanocones (MWCNC) between the transparent metallic electrode (FTO) and the semiconductor (CdS). Our preliminary results indicate the photocurrent through the semiconductor is strongly modified by the presence of the carbon nanotubes or carbon cones.

Assembling multi-functional nanostructures with two or more types of materials, using covalent or non-covalent approaches, can add or extend new functionalities of the new structures and opens the possibility of novel practical applications for these new hybrid materials.

In this work hybrid structures consisting of CdS thin films modified with MWNT or MWCNC were studied (Figure 1a-b). MWNTs were synthesized by decomposition of acetylene over an alumina supported palladium catalyst [1], while the MWCNCs were prepared by plasma activation, in an industrial scale process for the production of carbon microparticles [2]. Both materials were dispersed in 2-propanol with the help of an ultrasonic bath and then deposited through an aerograph (argon, 2 bar) on the surface of a conducting glass (FTO) surface.

Thin films of cadmium sulfide were deposited on the FTO-glass which has been previously "painted" with nanotubes or nanocones. The chemical bath used for the deposition had a mixture of 0.06M of cadmium sulfate and ammonia 1.74M. The mixture was kept at a constant temperature (75 ºC) during treatment. Pre-thermalized thiourea (0.12M) was added to the mixture, to induce the formation of CdS. In this solution $NH_3$ acts as a complexing agent, whereas the thiourea acts as sulfur source [3].

The optical properties of the synthesized hybrid materials where investigated (figure 1c). We examined the photocurrent (figure 2) induced by a 50 watt halogen bulb while the device rested in an electrolytic cell with a three electrodes configuration. A transparent electrolyte ($Na_3SO_4$, 0.1 M, pH 10) was used during the measurements. Our experimental results indicate the CdS thin film, modified with MWNTs, show a significant increase in the photocurrent with respect to the same structure using only pure CdS. These results are consistent with an increased efficiency in either the charge collection or charged pair production induced by the addition of MWNTs.

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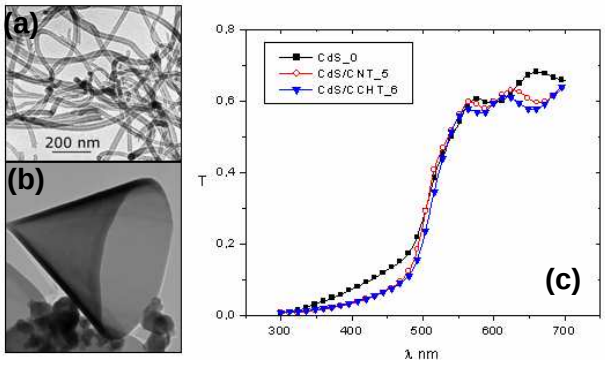


**Figure 1:** TEM image of a) carbon nanotubes b) carbon cones. c) optical transmitance for pure and modified CdS films.

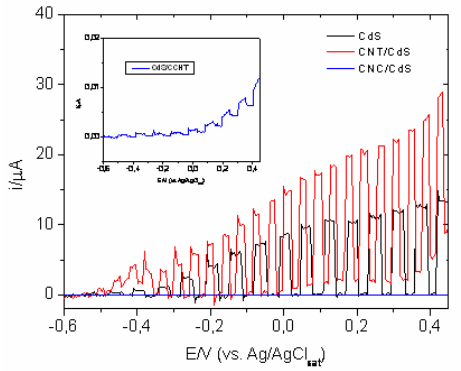


**Figure 2:** Photocurrent response of pure and modified CdS films.

## References

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