TiO_2 AND CdS NANOPARTICLES OBTAINED FROM SOFT TEMPLATING METHODS

Paulo J. G. Coutinho , Arlindo Garcia, Teresa V. Reis, Cândido Mendes, Teresa Barbosa
Centro de Fisica, Universidade do Minho, Portugal, 4710-057 Braga
pcoutinho@fisica.uminho.pt

Nanotechnology is a field of very active investigation. There is a wide scope of technological applications ranging from photocatalysis and sensors to fluorescence imaging. In this work, semiconductor nanoparticles are prepared by soft templating methods using the aqueous cavities of microheterogeneous media. We have used two main methods. In the first one (M1), adapted from Pileni et al [1], the spherical cavities of w/o microemulsions (reverse micelles) are used as templates. In the other (M2), a new method based in gel electrophoresis is used in which the metal ions and the corresponding anions, migrate under an electric field in opposite directions until they meet and react within the gel pores [2]. Method M1 was used for CdS and TiO_2 nanoparticles using either negative (AOT - sodium bis(2-ethylhexyl) sulfosuccinate), positive (CTAB – Cetyltrimethylammonium Bromide) or neutral (Brij®56 – polyoxyethylene 10 cetyl ether) surfactants. CdS nanoparticles were passivated with suitable capping agents. TiO_2 and CdS nanoparticles were successfully deposited as Langmuir-Blodgett films in glass slides. The obtained coated slides have photocatalytic properties as shown in figure 1.

The size dependence of CdS electronic states was obtained by a tight binding approximation [3]. Using these theoretical results, in conjunction with a size distribution and a Mie formalism for the scatter/absorption of nanoparticles of a given size, we were able to fit the experimental absorption and excitation spectra of CdS nanoparticles, either in AOT reversed micelles or in dried gels. In the case of AOT templating, the resulting particles should be spherical and the calculated average sizes can be compared to those obtained using empirical relations between first absorption peak and nanoparticle size proposed by Yu et al [4]. In the gel electrophoresis templating experiments, the effect of excess concentration of one of the ions, the presence of SDS surfactant and the type of gel, were found to influence the size distribution of the CdS nanoparticles and the corresponding photoluminescence spectra. (figure 2).

References:

[1] Cizeron, M. P. Pileni, J. Phys. Chem. **99** (1995) 17410.
[2] Paulo J.G. Coutinho, Candido A. G. Mendes, Teresa S. V. Reis, NYAS, in press.
[3] V. A. Fonoberov et al., Phys. Rev. B 66 (2002) 085310.
[4] W. William Yu et.al., Chem. Mater. 15(14) (2003) 2854.

Figures:

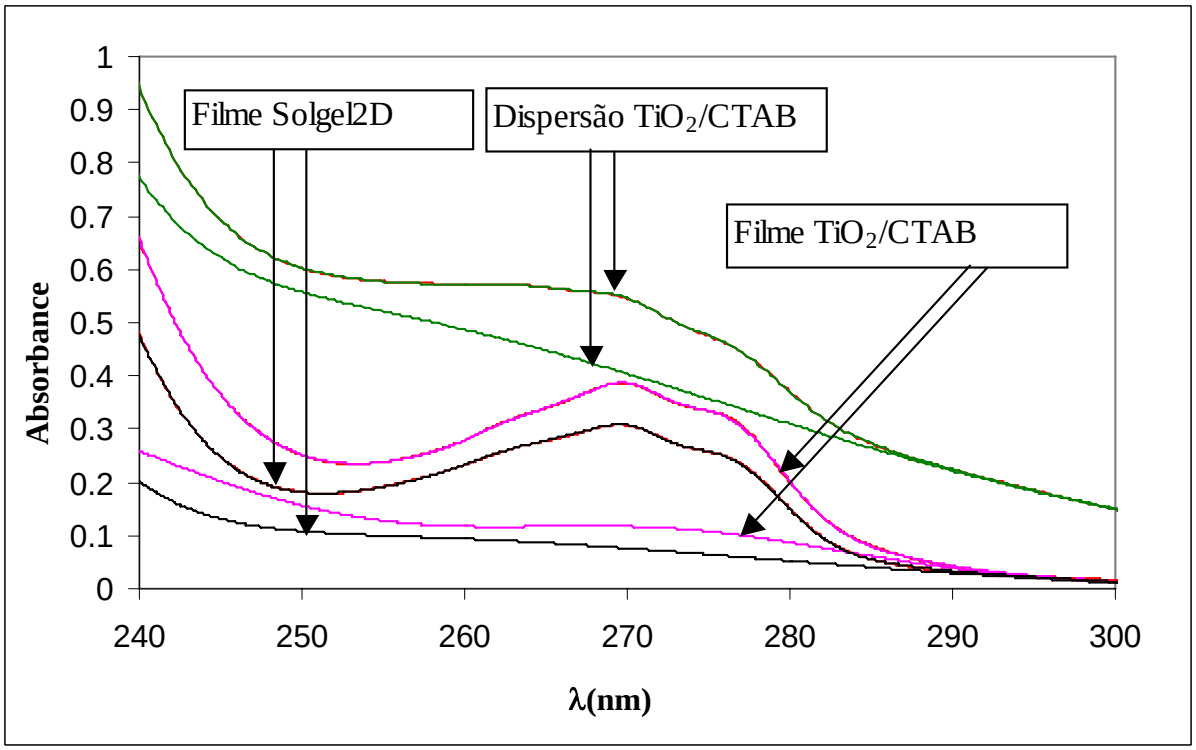

Figure 1: Photodegradation of phenol using TiO_2 nanoparticles.

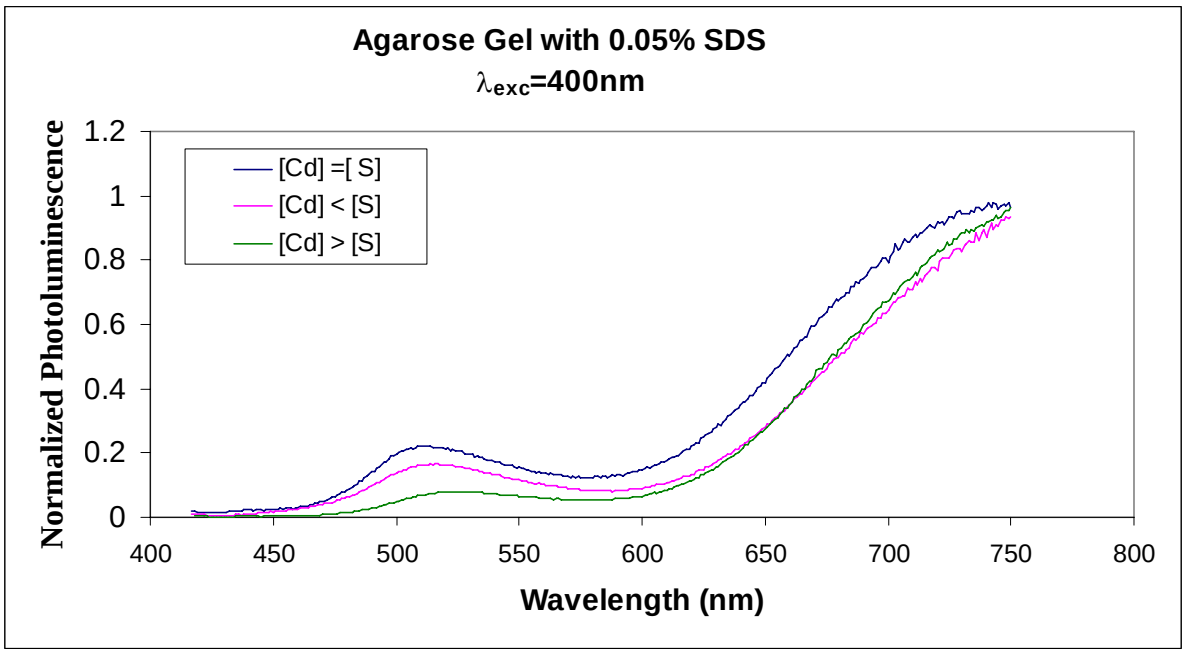

Figure 2: Photoluminescence of CdS nanoparticles obtained from templating with agarose gel electrophoresis.