Abstract No. 2786

Photoelectrochemical and Fluorescence Studies of II-VI Semiconductor Nanoparticles

Rachel Doherty and D Jason Riley
University of Bristol, School of Chemistry,
Cantocks Close, Bristol BS8 1TS, UK

Semiconductor nanoparticles have attracted a lot of attention recently due to their unique electronic, photophysical, photochemical and nonlinear optical properties, if the particle is small enough it will exhibit size-dependent optical and electronic properties, i.e., the onset of absorption is shifted to shorter wavelengths. These properties are leading to potential applications in many areas such as opto-electronics, photocatalysis, bio-imaging, light emitting diodes and solar cells

CdS nanoparticles have been prepared via colloidal science using $Cd(ClO_4)_2$ and H_2S with 3-mercaptopropionic acid as the stabilising agent. This method yields acid functionalised particles that can be attached directly to a hydroxy sensitised tin oxide coated glass substrate. CdS nanoparticles were self-assembled onto the substrate by arrested precipitation forming a sub-monolayer.
Colloidal CdS nanoparticles were characterised by UV-vis spectroscopy to determine particle size. The size of the particles has been shown to vary with varying amounts of stabilising agent. The modified electrodes were studied using photocurrent spectroscopy and potential modulated absorption spectroscopy (EMAS). Photocurrent spectroscopy results show that the particles attached to the electrode are comparable with those in the colloidal solution. EMAS is used to determine the relationship between the substrate Fermi level and the CdS conduction band. Previous EMAS studies of electrodes modified with a sub-monolayer of CdS nanoparticles, have shown weak, unexplained peaks at long wavelength, in addition to the band gap (~470nm) bleaching peak[1], Fig 1. We have shown that the long wavelength peaks are affected by the particles surface states, by varying the amount of Cd^{2+} and S during preparation and comparing the results to fluorescence data obtained, Fig 3.

We have also studied a method of sensitising TiO_2 coated electrodes with CdS nanoparticles for solar cell application, as an alternative to the previously studied dye-sensitised cells. The optical band-gap of nanoparticles can be tuned by manipulating particle size, making them sensitive to visible light.[2] Here we report sensitisation using CdSe nanoparticles prepared using bis(trimethylsilyl)selenium instead of H_2S as the selenium reagent. TiO_2 films were prepared on tin oxide coated glass electrodes by the well-established sol-gel method. CdSe nanoparticles were self-assembled onto TiO_2 films by arrested precipitation. Colloidal CdSe nanoparticles have been characterised by UV-vis spectroscopy and the $CdSe/TiO_2$ modified electrodes were investigated by fluorescence spectroscopy.

REFERENCES

1) Hickey, S.G., Riley, D.J., Tull, E.J., J. Phys. Chem. B, **104**, 7623-7626 (2000)
2) Peter, L.M., Riley, D.J., Tull, E.J., Wijayantha, K.G.U., Chem. Commun., **10**, 1030-1031 (2002)

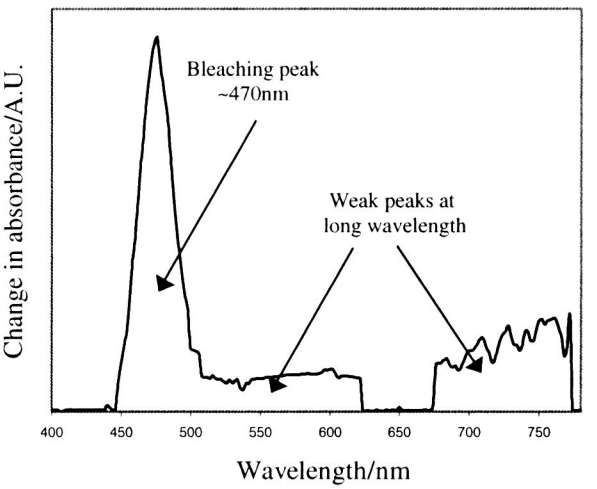

Fig 1: Potential modulated absorption spectra of a CdS modified electrode.

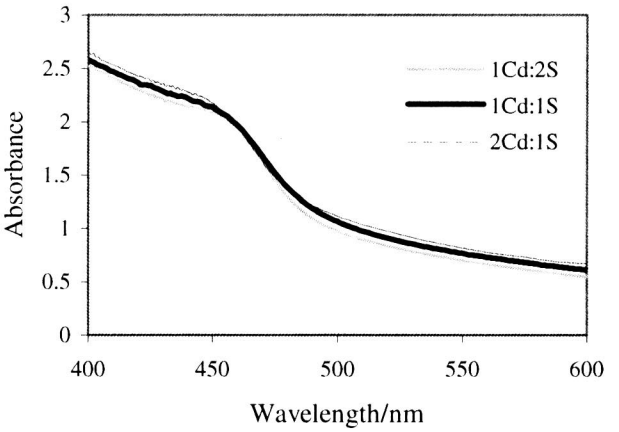

Fig 2: UV-Vis spectra of CdS Nanoparticles Prepared Using Different Ratios of Reagents

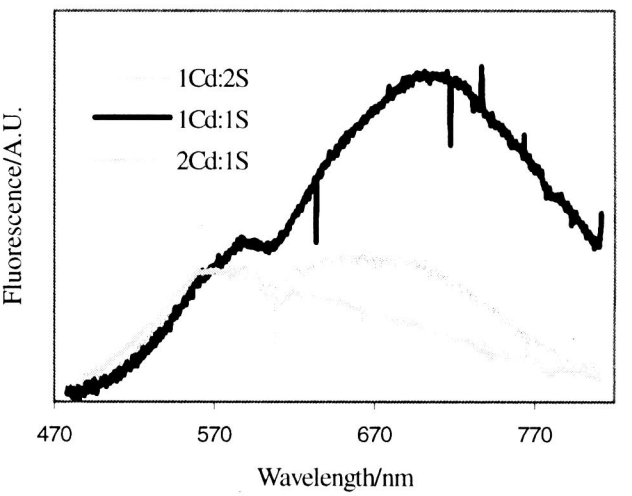

Fig 3: Normalised Fluorescence Study of Small CdS Nanoparticles Colloids