Investigations Into The Electronic Properties Of CdS Nanoparticles On Conducting Substrates

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Semiconductor nanoparticles are quantized exhibiting a change in their optical absorption with size, and have a large surface area to volume making them easily addressable to light. Differently sized CdS nanoparticles have a range of optical absorptions in the visible spectrum[1], making them ideal candidates for photoelectrochemical studies[2].

Mercaptopropionic acid was employed as a stabilizer in the preparation of CdS nanoparticles yielding acid functionalised particles that could be directly attached to a hydroxy sensitized tin oxide surface. Particle size control was confirmed by the use of UV-Visible spectroscopy and Low field SEM images and Ellipsometry have been used to support monolayer formation (figure 1).

Controlled fabrication of multilayer structures has been investigated using two different methods, the first uses a dehydration step involving a dithiol linking molecule, the second relies on acid chelation effects about free Cd^{2+} ions present at the time of construction.

Photocurrent spectra recorded from consistently sized multilayer structures at each stage of construction indicate the deposition of uniform multilayers (figure 2); exhibiting a uniform magnitude increase with each additional CdS layer.

Different concentrations of stabilizer have been employed in order to manufacture differently sized particles. Controlled deposition has allowed multilayer systems to be constructed in which particles of different sizes are coupled. These structures have been characterized using photocurrent spectroscopy.

Intensity Modulated Photoelectron Spectroscopy (IMPS) studies[3,4] have been employed to investigate charge transfer processes in the different multilayer structures (figure 3). Back electron transfer and stabilizer induced hole scavenging mechanisms have been considered

Figure 1 Low Field SEM picture of CdS on tin oxide coated glass

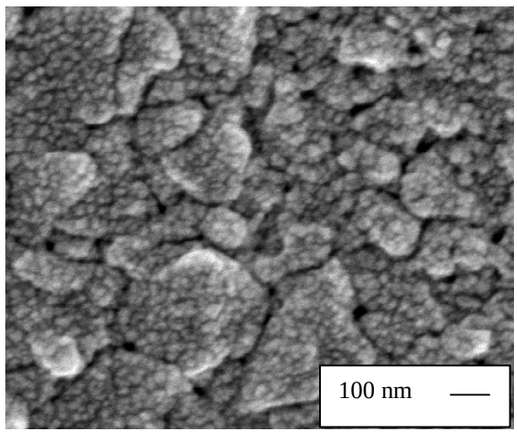


Figure 2 Photocurrent recorded at +0.2V for subsequent layers of CdS particles on a tin oxide coated glass electrode.

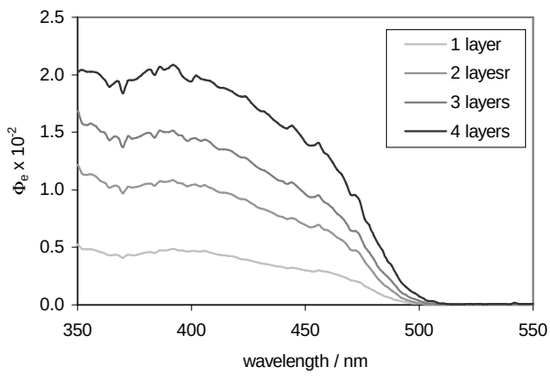
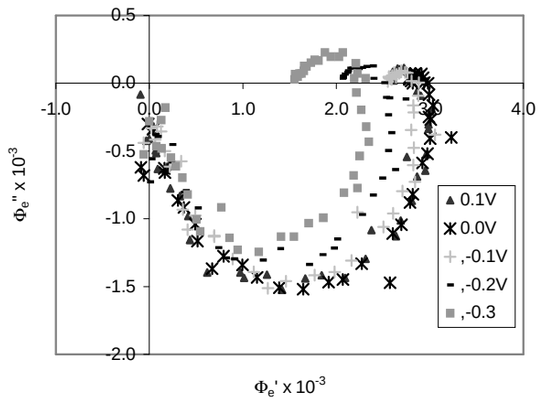


Figure 3 IMPS plots from a two-layer electrode illuminated with a 430nm LED.



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