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Photoassisted Deposition of Metal Selenides Using a Selenium "Template"

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In this paper, we focus on the use of selenium deposits to subsequently facilitate the photoassisted growth of metal semiconductor compounds. Metal selenides (generically represented as MSe) are important for many applications related to solar cells, xerography, chemical sensors, and the like. Two approaches to the photoassisted deposition (PAD) of MSe compounds will be described.

In the first, Se is first photodeposited on a UV-irradiated TiO_2 surface. When the solution is subsequently dosed with a metal ion (e.g., Cd^{2+}), cadmium is photodeposited on Se-rich regions on the TiO_2 surface to form CdSe. Interestingly and importantly, cadmium itself, in the absence of the selenium "template", would not have deposited on the titania surface on account of its rather negative reduction potential. Thus the PAD of cadmium is driven by the free energy of formation of CdSe (- 136.4 kJ/mol).[1] The mechanistic aspects of the PAD of CdSe on the TiO_2 surface will be discussed. In particular, Se^{2-} species are implicated in this novel process. Support for this comes from photo-chronopotentiometric data on TiO_2 films in Se(IV)-containing aqueous media.[2] Thus of the two possibilities, i.e., atomic or ionic growth of CdSe, these data favor the ionic mechanism.

Since Se is a p-type semiconductor, photoexcitation of Se can be used to generate electrons on its surface and thereby induce the PAD of MSe compounds. Note that this photoassisted process will occur at potentials that are positive of where electrogeneration of Se^{2-} species, and subsequent "dark" deposition of MSe, become important.[3] Examples of such PAD of MSe compounds on polycrystalline gold substrates, will be presented.

References

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