Photoelectrochemical Processes on CdSe Electrodes with Nanostructured Surface

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One of the promising directions of the modification of semiconductor electrodes is the application of nanosized metal or semiconductor particles to their surface, which in some cases improves photocatalytic processes [1, 2]. We present results of studying the effect of the surface modification of monocrystalline and polycrystalline CdSe electrodes on their photosensitivity in a polysulfide system used in electrochemical solar energy converters.

The electrode surface was modified by applying CdS nanosized particles. After a chemical etching CdSe in solution 1M CrO_3 on its surface was deposited the layer of nanosized CdS particles by a method of a chemical deposition. The thickness of this layer varied from 2 up to 8 nm. Is found, that at optimal width of a CdS layers 3 - 4 nm, the open circuit voltage in the electrochemical cell containing the polysulfide solution is increased on 0,20 - 0,30 V on a comparison with an CdSe electrode which is not containing surface layer CdS. At the same time the velocity of a surface recombination decreases on 1-2 order. After a deposition of CdS layer on CdSe electrode the solar energy conversion efficiency 13-14 % was reached.

The photo-emf relaxation kinetics under lighting the electrodes with a pulsed dye laser has been studied. It has been shown that the density of "fast" surface recombination centers on the modified surface was decreased by an order of magnitude and was $6 \cdot 10^8$ cm^{-2}. By measuring the electrode impedance under lighting it has been found that the density of "slow" recombination centers decreased by a factor of 3-4, which led to an increase in electrode photopotential. The potential range has been determined where the recombination processes on the modified surface are not severe, in consequence of which the quantum yield of photoelectrochemical current reached 0.65-0.75 in a wavelength range of 280-550 nm.

References:

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