E2-47 Colloidal p-CuI sensitized double dye system

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Recently a great deal of interest has developed in making dye-sensitized solar cells using wide band gap semiconductors in colloidal form because of having a large surface area exposed to adsorb a large number of dye molecules. Recently, it was reported that p-CuI can be deposited on various materials maintaining the surface character as porous. Here, colloidal p-CuI deposited on copper substrates is sensitized with double dye systems of Crystal Violet (CV) and Rhodamine Iodide (R-I) dyes. Colloiodal p-CuI is deposited (5 mg powder CuI dissolved in (0.1 M) acetonitrile) on a copper plate and (R-I is deposited by simple dipping technique on p-CuI as the first dye. After that, second dye CV is deposited on R-I deposited p-CuI, to prepare the double dye device (p-CuI/R/CV). This system shows a photocurrent enhancement in the photocurrent action spectra, when compared to that of bare dye-sensitized systems. Double dye system p-CuI/CV/RI cannot be prepared since it is difficult to deposit R-I on CV.

In the photocurrent action spectrum of p-CuI/R/CV, clearly 2 peaks appear at $\lambda = 500$ nm and $\lambda = 610$ nm. Absorption spectrum of p-CuI/R-I/CV shows two peaks around 500nm and 610 nm. Photocurrent action spectrum for p-CuI/CV shows a broad spectrum while that of p-CuI/R shows a sharp peak at λ=580 nm. Following mechanisms are proposed for the formation of two peaks in the photocurrent action spectrum of the double dye system.

Peak at 500nm:

$$CV + h \text{ ---------- } CV^*$$
$$CV^* + R\text{-}I \text{ ---------- } CV + R\text{-}I^*$$
$$R\text{-}I^* \text{ ---------- } R\text{-}I^- + h \text{ (VB p-CuSCN)}$$
$$R\text{-}I^- + X \text{ (electron acceptor) ---------- } R\text{-}I + X^-$$

Peak at 610nm:

$$CV^* + R\text{-}I \text{ ---------- } CV + R\text{-}I^*$$
$$R\text{-}I^* \text{ ---------- } R\text{-}I + h \text{ (VB p-CuSCN)}$$
$$CV^- + X \text{ ---------- } CV + X^-$$

LUMO and HOMO levels of CV and R-I at p-CuI/R-I/CV are supported to happen the above mechanisms. Also the possibility of the generation of photocurrent through resonant energy transfer between two dyes with photon emision is extremely low since the double dye system is transparent to the incidenct photon flux.

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