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Enhanced dye sensitized photocurrent by interlocked langmuir-Blodgett dye films

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Dye sensitized photo-electrochemical (PEC) cells based on Cu/P-CuSCN/LB films have been studied with mixed Langmuir-Blodgett (LB) films as the dye layer. The effects of mixed layers were investigated in detail by observing the changes of π-A isotherms, optical and photocurrent in a PEC cell configuration. It is interesting to mention that the isotherm of the mixture of R-C_{18} + C_{18}-R-C_{18} resembles the (π-A) of bare C_{18}-R-C_{18} when the molecular ratio of the mixture is (1:1). The average molecular area calculated for bare C_{18}-R-C_{18} (180Å²) is larger than the average molecular area of bare R-C_{18} (150Å²). Then, it is possible to occupy R-C_{18} dye molecules between the two –C_{18} chains of the C_{18}-R-C_{18} molecules in the R-C_{18} + C_{18}-R-C_{18} (1:1) mixture. Enhancements in both optical absorption and photocurrent were found when a mixture of R-C_{18} (octadecyl rhodamine) and C_{18}-R-C_{18} (dioctadecyl rhodamine) were depositing using the LB technique on p-CuSCN wide band gap semiconductor. The maximum photocurrent quantum efficiency of the PEC cell reached 14% in KI (10^{-4}M) + I_2 (10^{-3}M) electrolyte solution when mixed LB films were used as the dye layer. In the case of bare R-C_{18} + C_{18}-R-C_{18} LB films deposited on p-CuSCN, a photocurrent enhancement can be observed when the numbers of LB dye films are increased; photocurrent enhances and maximizes around 5 mono-layers. When the number of LB films becomes thicker with 9 mono-layers, the photocurrent was found to decrease, most probably due to the reduction of current in the presence of increased resistance of the system. Photocurrent enhancement is believed to be the enhancement of light absorption of the dye layers due to the interlocking R-C_{18} between the double C_{18} chains of rhodamine.

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