

EFFECT OF PHOTOSENSITIZER LOADING IN SOME EFFICIENT BULK HETEROJUNCTION PHOTOVOLTAIC CELLS BASED ON RHENIUM(I) AROMATIC DIIMINE COMPLEXES

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We report the fabrication of some efficient photovoltaic cells using a rhenium(I) aromatic diimine complex as the photosensitizer. These complexes exhibit relatively long-lived triplet excited states with metal-to-ligand charge transfer character. After photoexcitation, the excitons formed may have longer lifetime, which facilitates subsequent exciton dissociation process.¹⁾ This type of diimine complexes could also function as charge transport molecules²⁾ with bipolar character (hole and electron mobilities in the order of $10^3 \text{ cm}^2\text{V}^{-1}\text{s}^{-1}$). Metal complex thin films can be conveniently fabricated by sublimation under vacuum. Different bulk heterojunction photovoltaic cells with the structure ITO/copper phthalocyanine/rhenium complex: C_{60} / C_{60} /Al were fabricated. The rhenium complex to fullerene ratio can be adjusted by modifying the deposition rate of each compound.

Figure 1 shows the current-voltage characteristics of these photovoltaic cells under illumination of simulated solar light. For the device with rhenium complex to fullerene ratio of 1:1, the open circuit voltage, short circuit current, fill factor, and power conversion efficiency were measured to be 0.46 V, 3.4 mA/cm^2 , 0.47, and 0.7 %, respectively. For the device with lower metal complex loading (rhenium complex:fullerene = 1:9,) they were measured to be 0.37 V, 2.7 mA/cm^2 , 0.4, and 0.39 %, respectively. These results indicated that the rhenium complex is an efficient photosensitizer, and relatively small amount is enough to generate excitons in the photoexcitation process. In addition, the presence of fullerene is also essential in the exciton separation process. Atomic force microscopic studies showed that these metal complex/fullerene blends exhibited no significant aggregation. These observations suggest that the rhenium complex and fullerene molecules are highly compatible to each other. Further optimization of cell performance is expected by careful adjustment of each active layer.

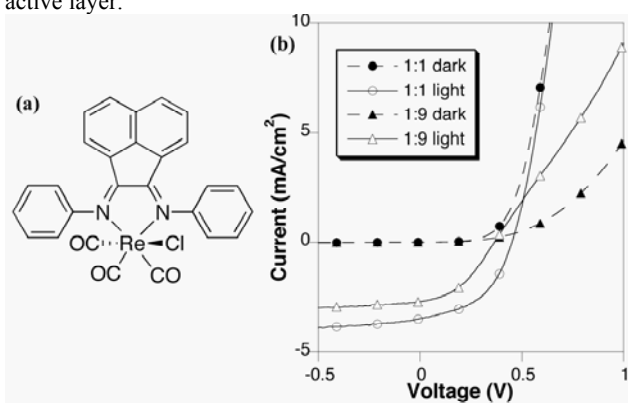


Fig.1 (a) Structure of the rhenium aromatic diimine complex. (b) Current voltage characteristics of bulk heterojunction photovoltaic cells with different rhenium complex to fullerene ratios.

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