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Cu_2HgI_4 IN DYE SENSITIZED SOLID STATE SOLAR CELLS

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Dye-sensitized solar cells have achieved high efficiency values. But their electrolytes have problems like leakage, volatility, corrosion of electrodes and degradation due to UV light. Therefore, new solid electrolytes are needed to be investigated. Copper(I) tetraiodomercurate(II) (Cu_2HgI_4) has high ionic conductivity due to migration of copper ions in tetrahedral sites in crystal lattice which is similar to zinc blende structure. Ionic conductivity of Cu_2HgI_4 drastically increases to larger value when temperature is increased above phase transition temperature (67 °C) which gives a more disordered phase. Therefore, Cu_2HgI_4 can be used as a hole transporting material in dye-sensitized solid state solar cell.

Cu_2HgI_4 was synthesized from solid state reaction between HgI_2 and CuI in 1:2 molar ratio. Cu_2HgI_4 was characterized from X-ray diffraction (XRD) studies. XRD spectrum of Cu_2HgI_4 had accurate peak positions and there were no peaks for HgI_2 and CuI. TiO_2 layer was made from drop casting a TiO_2 suspension and N 719 dye was the photosensitizer. Cu_2HgI_4 was applied on dye absorbed TiO_2 layer by drop casting a solution which was made by dissolving Cu_2HgI_4 in acetonitrile.

Two sets of I-V data were obtained for each solar cell by using a counter electrode (CE) consisting of (a) a lightly platinized fluorine doped tin oxide (FTO) plate and (b) graphite and a metal (Cu, Pt) contact. Solar cells with graphite CE have a higher efficiency than those with Pt CE. One reason for this difference may be due to the fact that graphite has a lower work function (φ) than Pt. Solar cells with graphite/Cu metal contact as the counter electrode has a higher J_{sc} and a higher efficiency than those with graphite/Pt CE. Because Fermi level (FL) of Cu is closer to FL of graphite, than FL of Pt to the FL of graphite, electron transfer can be expected to be more efficient between graphite and Cu than between graphite and Pt. High conductivity in α-phase of Cu_2HgI_4 did not increase efficiency of the solar cell. Best efficiency value (η%) of 0.200 are obtained for the cell with J_{sc} = 1.118 mA cm^{-2}, open circuit voltage (V_{oc}) = 0.486 V, fill factor (FF) = 0.368, having the configuration, FTO/TiO_2/N719/Cu_2HgI_4/graphite-powder/Cu solar cell. I-V characteristics of this solar cell were calculated with considering the active area as 0.25 cm^2.