Dye sensitized solar cells employing molten salt electrolyte

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Dye-sensitized solar cells (DSCs) are a promising technology for realizing solar cells with high conversion efficiency and low cost compared to silicon-based solar cells. Unlike silicon-based solar cells, however, dye-sensitized solar cells contain liquid electrolytes. The electrolytes normally used in DSCs based on Ru-complex photosensitizers, contain redox species (I^-/I_3^-) and volatile organic solvents such as acetonitrile. The use of liquid electrolyte in DSCs, however, possesses several practical problems including leakage of the electrolyte, desorption of the sensitizing dye by the organic solvent used in the electrolyte, and toxicity of some of the organic solvents. Efforts have been made by many academics and industrial laboratories to develop practical, high performance DSCs that combine high efficiency and good stability with easy processability. A solid or quasi-solid charge transporting material will avoid the leakage problems, in addition allowing easy application of these materials using a cost effective manufacturing process. Solid-hole transport materials and solvent free polymer electrolyte incorporating iodide and triiodide have been introduced to replace the liquid electrolytes, but the efficiencies of these devices are still relatively low. The use of non-volatile liquids or room temperature molten salts (ionic liquids) such as imidazolium salts and pyridinium salts with high ionic conductivity at room temperature would be a solution to these problems. Keeping these in mind, we fabricated dye sensitized quasi solid solar cells using solid composite materials of LiSCN and methyl-hexyl-imidazolium iodid (MHImI) as hole transport materials to replace liquid iodide and polyiodide electrolyte with volatile solvents. The devise based on 3.1 μm nanocrystalline TiO_2 film absorbed by monolayer of Ruthenium dye complex (N719), shows excellent incident photon-to-electron conversion efficiency (IPCE, ~ 75%) , large current density (11.6 mA cm^{-2}), and high light to electric energy conversion efficiency (5.3- 6.1%) under the illumination of 100 mW cm^{-2}. (AM 1.5).