Development of I_2-Free Solid-State Dye-Sensitized Solar Cells employing Room Temperature Processable Conducting Polymer

고종관, 김병관, 김정훈, 김상진, 김동준, 허성연, 김종학*
연세대학교
(jonghak@yonsei.ac.kr*)

A novel solid-state polymerizable monomer at 25°C, i.e. 2,5-dibromo-3,4-propylenedioxythiophene (DBProDOT) is designed and synthesized to produce a conducting polymer, poly(3,4-propylenedioxythiophene) (PProDOT). Crystalographic studies reveal a lower activation energy, higher exothermic reaction and closer interplane distance of the DBProDOT crystal, which are responsible for polymerization at low temperautre. Upon solid-state polymerization (SSP) at 25 °C, PProDOT is at self-doped state with tribromide ions, having an electron conductivity of 0.05 S cm^{-1}, which is much higher than that of chemically polymerized PProDOT (2×10^{-6} S/cm). The PProDOT deeply penetrates into the nanocrystalline TiO_2 photoelectrode and functions as a hole transporting material (HTM) for iodine(I_2)-free solid-state dye-sensitized solar cells (ssDSSCs). Upon the introduction of an organized mesoporous TiO_2 (OM-TiO_2) layer, an energy conversion efficiency reaches 3.5 % at 100 mW/cm^2, which is quite stable at least up to 2,000 h.