Electronic Supplementary Material (ESI) for Energy & Environmental Science

Dye-sensitized Solar Cells on Glass Paper: TCO-free Highly Bendable Dye-sensitized Solar Cells Inspired by Traditional Korean Door Structures

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Supporting Information

Experimental Details

Glass microfiber filters (CHMLAB Group, GF1 grade filter paper) were used as glass paper. Commercial 304 stainless steel (325 mesh) was used as the metal mesh. A 100-nm Pt thin film was deposited on one side of the glass paper by direct-current sputtering. The stainless steel mesh was cleaned with acetone, ethanol, and water by sonication and dried in oven at 70°C overnight. After cleaning, a 300-nm Ti thin film was deposited on both sides of the stainless steel mesh by sputtering, followed by heat treatment at 480°C for 1 h in air. The side of the glass paper opposite the Pt thin film was coated with TiO_2 paste containing 500-nm TiO_2 particles (EnB Korea), and the surface-treated stainless steel was placed on the glass paper before the paste dried. After drying in oven at 70°C for at least 2 h, TiO_2 paste containing 20-nm TiO_2 nanoparticles (CCIC, NR18 grade) was deposited on the stainless steel mesh, followed by heat treatment to bond the glass paper to the stainless steel mesh at 480°C for 1 h in air. The 20-nm TiO_2 paste was deposited on the stainless steel mesh two or three more times using 3M tape as a mask, followed by heat treatment at 480°C for 1 h in air. For measurements, the active area size was 6 mm × 6 mm. After loading N719 dye (Solaronix SA) on the sintered electrode by immersion, the cell was cladded with PET-based laminated pouch film (0.1 mm thick, Sindoh Commerce) using a commercial hot-roll-coating machine (Sindoh Commerce, TL-4600). Before cladding, a small hole was made on one side of the cladding film for acetonitrile-based electrolyte (Solaronix SA, AS50) filling using a syringe. It should be noted that Ti wire (1 cm long × 0.1 mm wide) was place on the Pt-coated side of the glass fiber so that one end of the Ti wire was exposed to the external environment through the cladded film for electrical contact. The energy-conversion performance of the DSSCs was evaluated using a solar simulator (Abet Technologies, model Sun 2000, 1000 W Xe source, Keithley 2400 source meter) under 1.5 AM, 1 sun condition, calibrated by a KG-3 filter and NREL-certified reference cell without a mask. The energy-conversion efficiency of DSSCs under bending was measured by rolling the prepared cell on the surface of glass cylinders with corresponding radii.

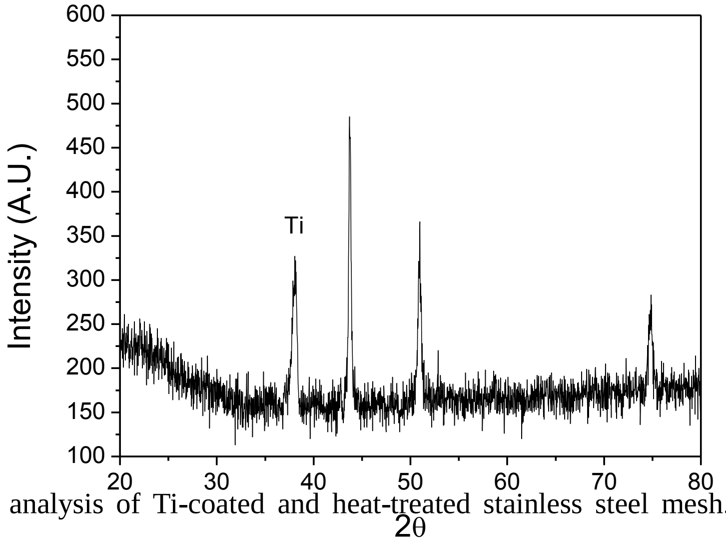
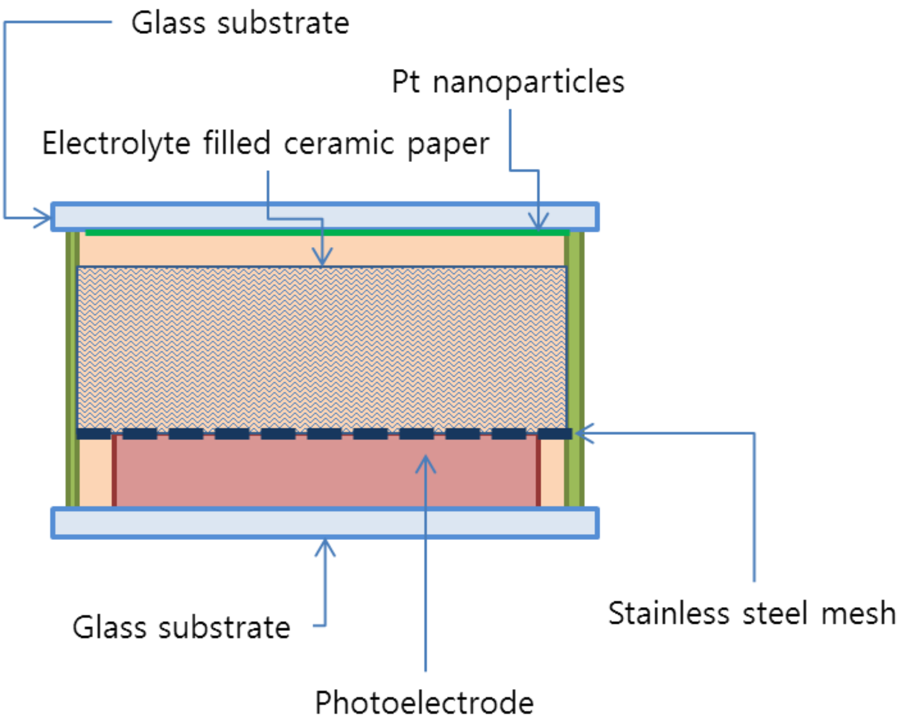
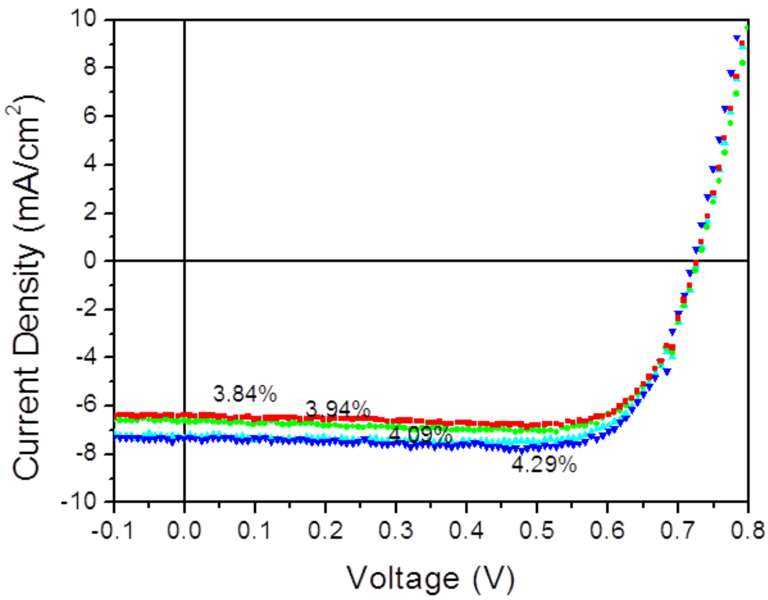


Figure S1. XRD analysis of Ti-coated and heat-treated stainless steel mesh. The unmarked peaks correspond to stainless steel.



(a)



(b)

Figure S2. (a) Schematic illustration of DSSCs prepared with stainless steel mesh bonded to glass paper and a Pt nanoparticle-coated FTO-coated glass substrate as counter electrodes and (b) their I–V characteristic curves.