Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics
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Support Information for

Low-cost Bio-inspired Integrated Carbon Counter Electrode for High-Efficiency Dye-sensitized Solar Cells

Chunlei Wang, Fanning Meng, Mingxing Wu, Xiao Lin, Tonghua Wang , Jieshan Qiu, and Tingli Ma**

State Key Laboratory of Fine Chemicals, Carbon Research Laboratory, School of Chemical Engineering, Dalian University of Technology 116024, China

Corresponding Author: wangth@dlut.edu.cn; and tinglima@dlut.edu.cn

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S1. Fabrication of DSSCs

The DSSCs were fabricated with a photoanode, a CE, and an electrolyte containing 0.06 M of LiI, 0.6 M 1-butyl-3-methylimidazolium iodide, 0.03 M I_2, 0.5 M 4-tert-butyl pyridine (TBP), and 0.1 M guanidinium thiocyanate in acetonitrile. The active area of DSSCs is 0.16 cm^2 used for photovoltaic performance test. The symmetrical dummy cells with an active area of 0.25 cm^2 were fabricated with two identical counter electrodes clipping the electrolyte the same as the one used in DSSCs.

Preparation of photo anodes: A 12 μm thick film of TiO_2 nanoparticles (average particle size 20 nm, Degussa, Germany) was coated on cleaned FTO glass by screen-printing. The TiO_2 film was sintered at 500 °C for 30 min, and then cooling to 80 °C. The resulted film was immersed in a 5×10^{-4} M solution of N719 dye (Solaronix SA, Switzerland) in acetonitrile/tert-butanol (v:v=1:1) for 12 h.

S2. Characterization

The scanning electron microscopy (SEM) measurements of the pure carbon CE were conducted on a FEI Hitachi S-4800(USA). Nitrogen sorption measurement was carried out with an Antosorb-1 Apparatus (Antosorb-1, Quantachrome, USA). The sheet resistances of counter electrodes were measured by using a four-point resistivity measurement system (RST-9, China). Photovoltaic performance of the DSSCs was conducted in simulated AM 1.5 illumination (100 mW cm^{-2}, PEC-15, Pcecell, Japan) with a Keithley digital source meter (Keithley 2601, USA). Incident photon to current conversion efficiency (IPCE) was measured on a Hypermono-light (SM25, Jasco Co.

Ltd., Japan), which was calibrated with a monocrystalline silicon diode. The electrochemical impedance spectroscopy (EIS) experiment was carried out using a computer-controlled potentiostat (Zennium Zahner, Germany). The measured frequency ranged from 100 m Hz to 1 M Hz, while the AC amplitude was set at 10 mV. The bias of all EIS measurements was set at -0.75 V. The EIS spectra were fitted by Z-view software. The equivalent circuit diagrams were shown in **Fig. S1**.

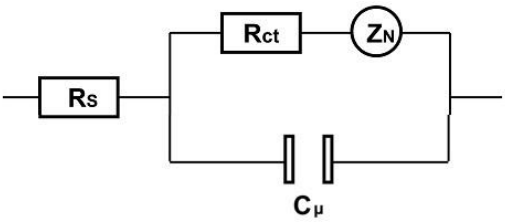
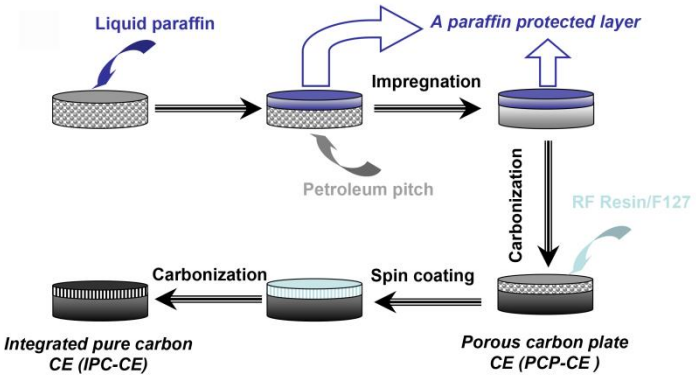


Figure S1 Equivalent circuit for fitting EIS plots. R_s: series resistance, R_{ct}: charge transfer resistance in the electrode/electrolyte interface, $C\mu$: corresponding capacitance in the electrode/electrolyte interface, Z_N: Nernst diffusion resistance.



Scheme S1 The fabrication procedure of the integrated pure carbon counter electrode for DSSCs.

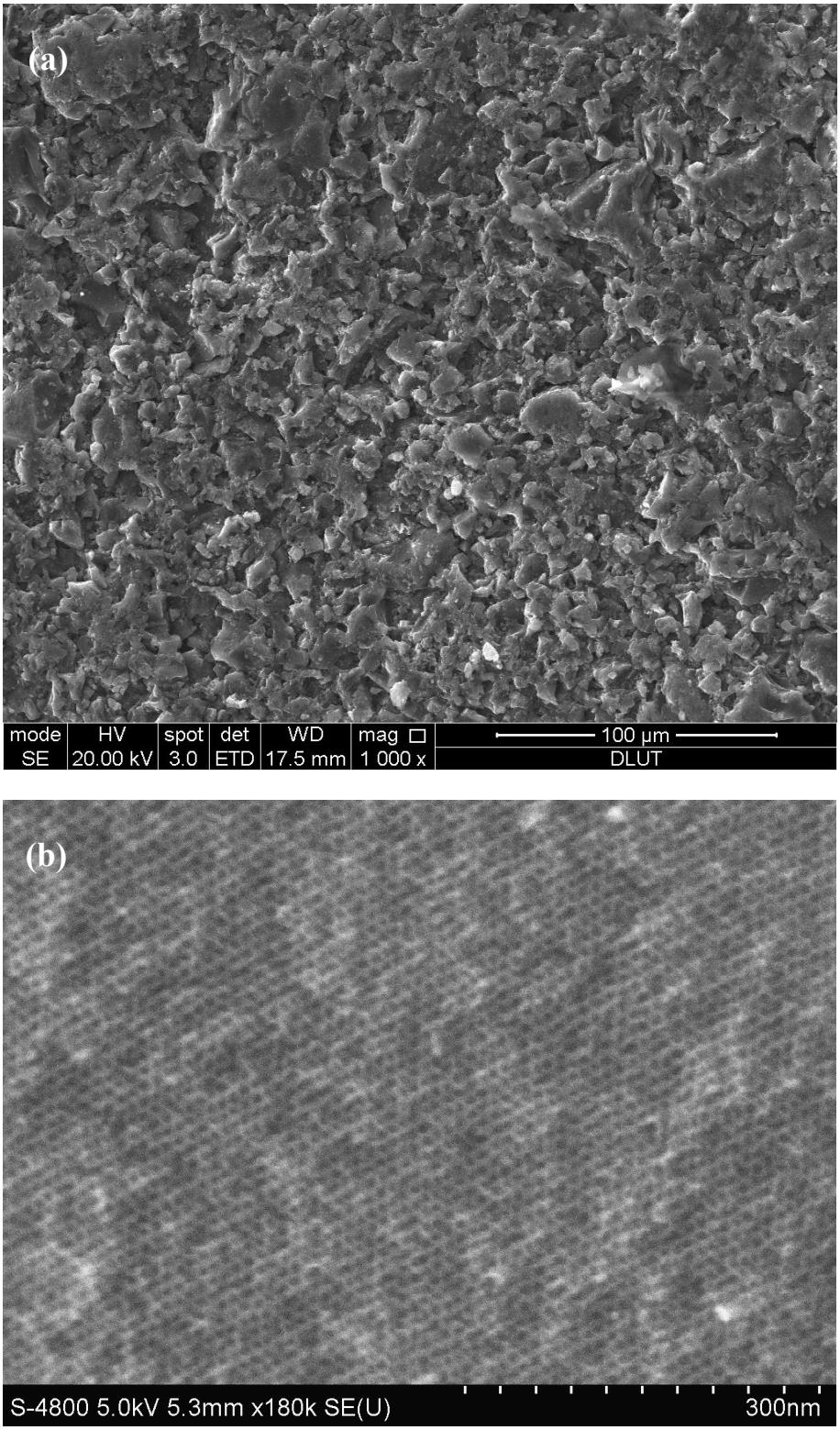


Figure S2 (a) Top-view SEM images of PCP; and (b) Top-view SEM image of OMC film in a large scale.

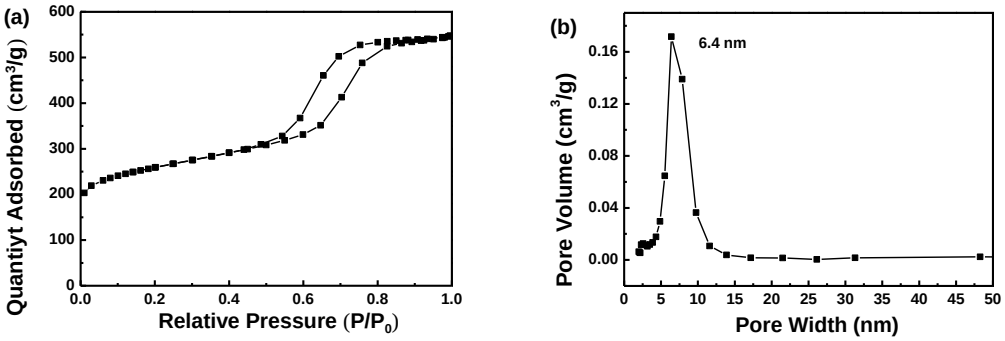


Figure S3 N_2 adsorption/desorption isotherms (a) and pore size distribution (b) of OMC catalyst layer. OMC exhibits a type IV isotherm with an H1 hysteresis loop indicating a mesoporous material with cylindrical pores.

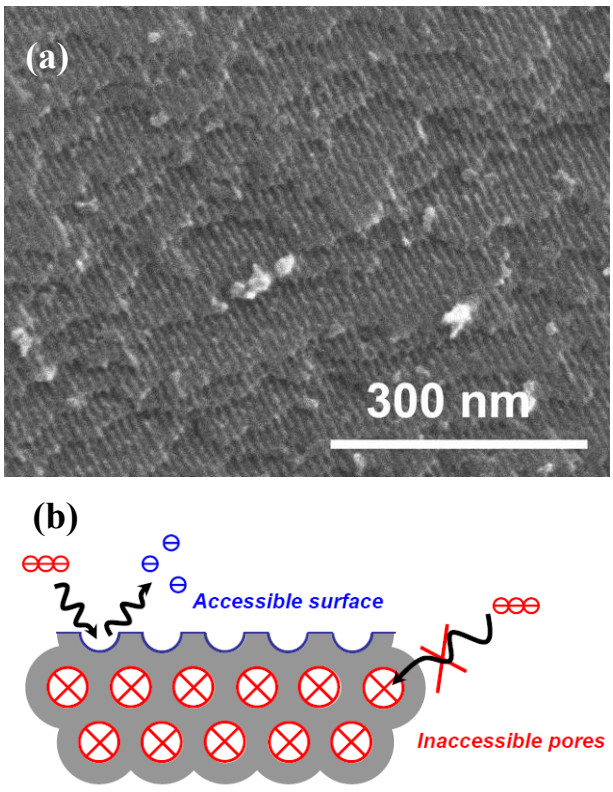


Figure S4 (a) Top-view SEM image and (b) schematic model of IPC-CE with a thicker OMC layer.