Supporting information

Ordered Mesoporous SnO_2 Based Photoanodes for High Performance Dye-Sensitized Solar Cells

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Synthesis of KIT-6 silica

Mesoporous KIT-6 silica was synthesized by following published procedures.[1] Nitrogen sorption isotherm in Figure.S1 indicates the mesoporous structure of the KIT-6 silica with pore size distribution centered at 8 nm. The Brunauer-Emmett-Teller (BET) surface area and pore volume of KIT-6 silica are 874 m^2/g and 1.14 cm^3/g, respectively.

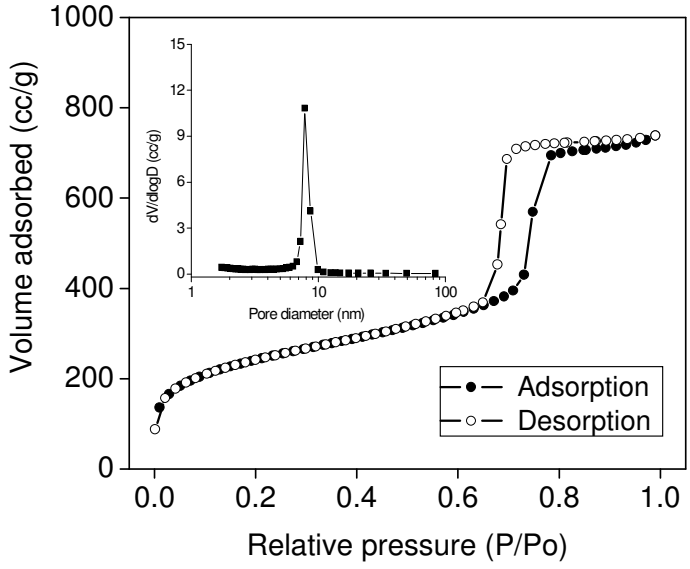

Figure S1. N_2 sorption isotherm and the corresponding BJH pore size distribution (inset) of KIT-6 silica obtained from the adsorption isotherm.

Synthesis of ordered mesoporous SnO_2

Ordered mesoporous SnO_2 (here after, meso-SnO_2) was synthesized by using $SnCl_2.2H_2O$ as a tin precursor and KIT-6 silica as a hard template. Figure S2 schematically shows the possible scenario during the nanocasting process. The impregnation of $SnCl_2.2H_2O$ in both chiral channels resulted in meso-SnO_2 with 3 nm pores while filling in either one of two chiral channel leads to ~20 nm wide pores. [2,3]

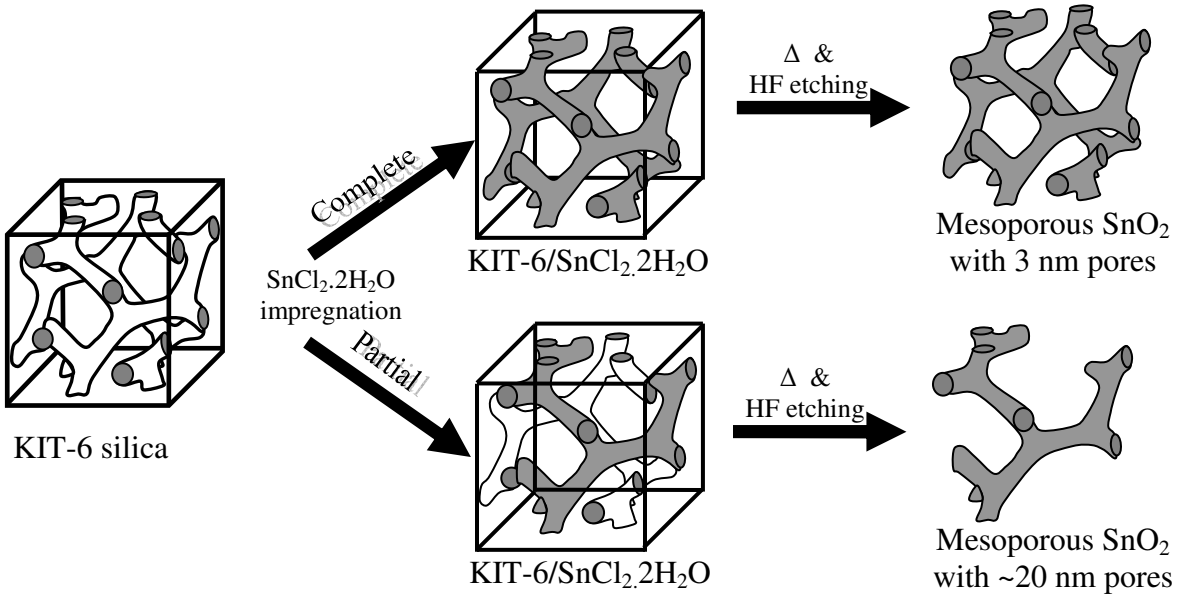

Figure S2. Schematic representation of ordered mesoporous SnO_2 with bimodal pores, replicated from KIT-6 silica template.

SEM and TEM images

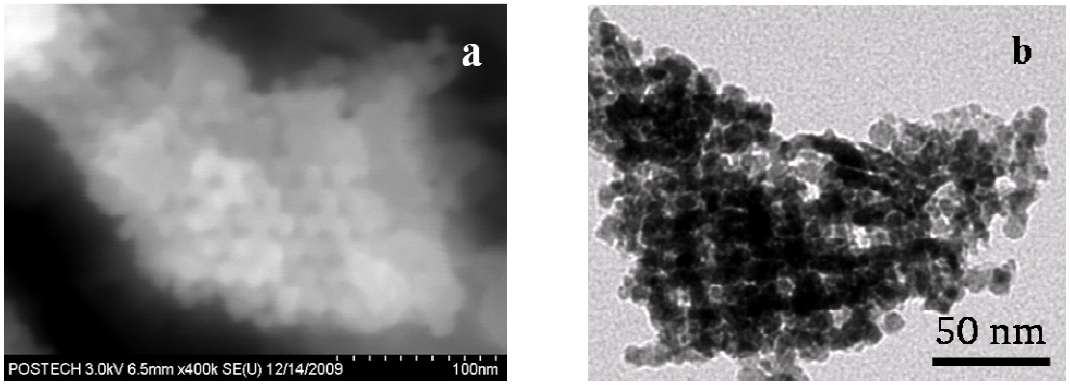

Figure S3. (a) SEM , and (b) TEM images of meso-SnO_2 powders. These two images show the large size pores which are generated by the impregnation of precursor in either one of two chiral channels.

Small angle X-ray scattering pattern

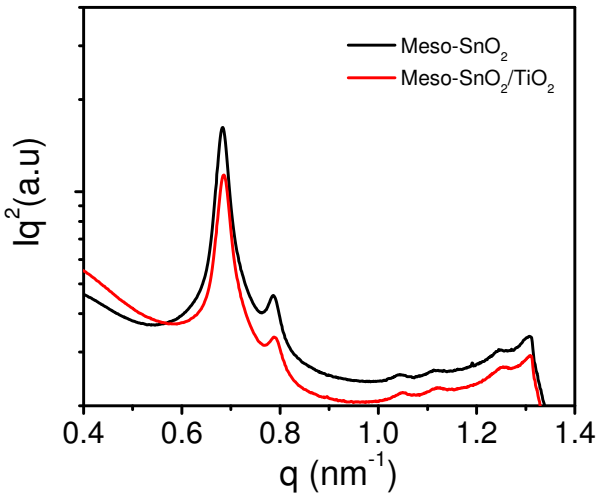

Figure S4. Small angle X-ray scattering (SAXS) pattern of meso-SnO_2 and meso-SnO_2/TiO_2 core-shell powders.

SEM cross section view of photoanodes

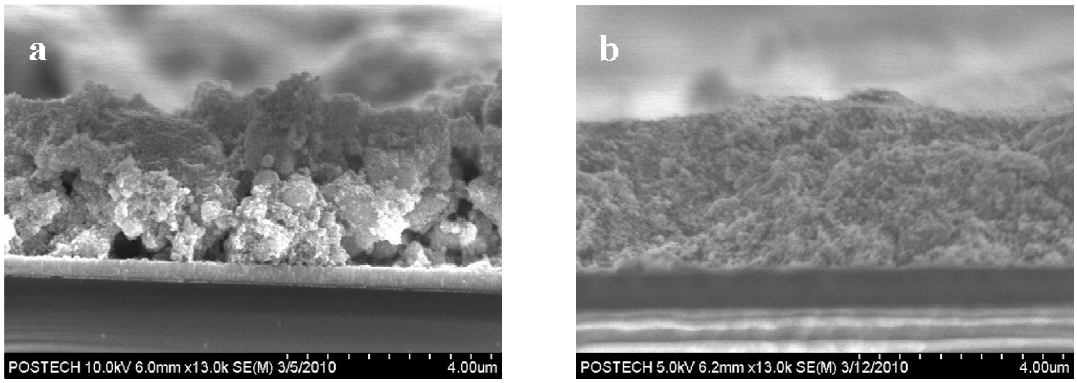

Figure S5. Cross-sectional SEM images of (a) Meso-SnO_2, and (b) Nano-SnO_2 photoanode.

Photoinduced degradation mechanisim in DSSCs

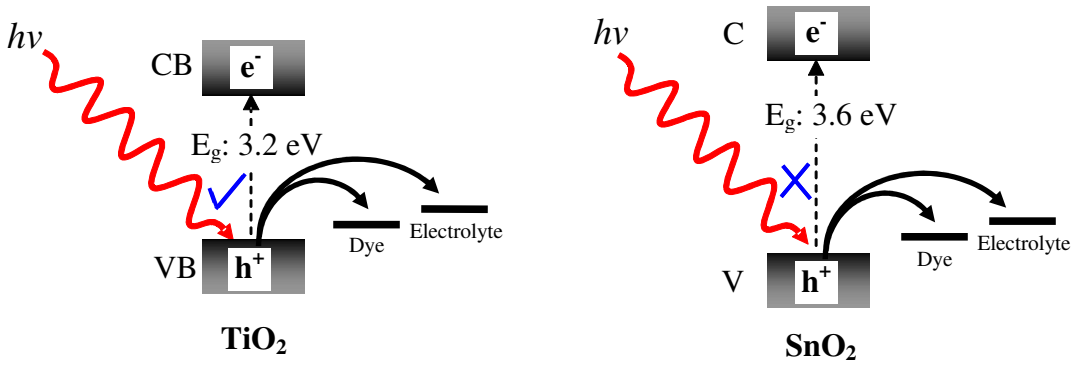

Figure S6. Schematic of photoinduced degradation mechanisim in DSSCs. Incident photon with sufficient energy liberates electron from the valence band of TiO_2 and thereby creating holes (h^+). These holes are likely to i) oxidize the dye molecules and degrade the TiO_2 /dye interface, ii) irreversibly oxidize the I^- to I_3^- and leads to the unrecoverable loss of I_3^- ions in the redox electrolyte. [4,5] These both outcomes are notably affect the overall stability of DSSCs. To prevent the photo-induced degradation in TiO_2

photoanode DSSCs, UV cut-off filter is typically placed on the front side of the device and accelerated aging tests are carried out.[6] On the other hand, larger band gap of SnO_2 would create fewer oxidative holes in the valence band thereby minimize the dye degradation and improve the long-term stability of DSSCs.

References:

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