

SnO₂ Nanowall-arrays Coated with Rutile-TiO₂ Nanoneedles for High Performance Dye-sensitized Solar Cells

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Characterizations

Crystal structure of SnO₂ nanowalls electrodes was determined using X-ray diffractometer (Rigaku D/MAX 2500 V, Cu K α , λ = 0.15418 nm). The thickness and morphology of the SnO₂ nanowall electrodes were checked with a scanning electron microscope (SEM, Hitachi S-4200). Solar-to-electric power conversion efficiency of the devices were measured by, incorporating individual and dual-sensitized SnO₂ electrodes into a thin layer sandwich-type cells. A Pt-coated FTO was used as counter electrode which was prepared by drop casting 0.04 M isopropanol solution of chloroplatinic acid on FTO followed by heating at 450 deg for 20 min., using a spacer film (50 μ m thick polyester film) and an electrolyte Iodolyte An-50. Cell performance was measured by irradiation with 100 mW/cm² white light (1 Sun) with Air Mass (AM) 0 and 1.5 filters as a solar simulator in the presence of a water filter (450 W xenon lamp, Oriel Instruments). Current was measured by using a Keithley 2400 source meter. Electrochemical impedance spectra were recorded with an Impedance Analyzer (COMPACTSTATe: IVIUM Technologies) in a frequency range of 0.01 Hz to 1.5 MHz with 50 mV amplitude. The measurements of EIS were carried out at open circuit potentials under 1 sun AM 1.5 G light illumination. Impedance parameters were determined by fitting impedance spectra using Z-view software.

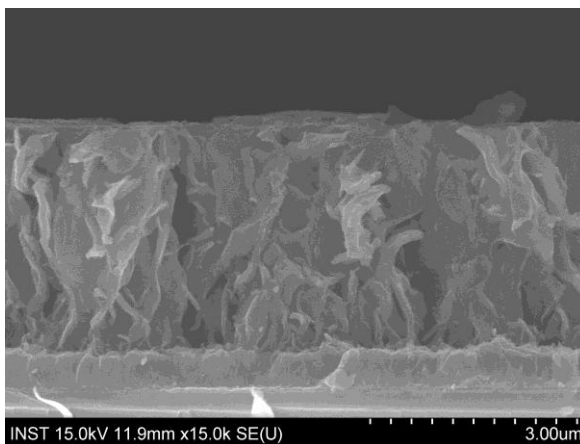


Fig. S1. Cross- section SEM image of SnO₂ nanowall arrays on FTO showing thickness around 3.2 μm.



Fig. S2. High resolution SEM image of SnO₂ nanowall electrode showing full coverage of TiO₂ nanoneedles.

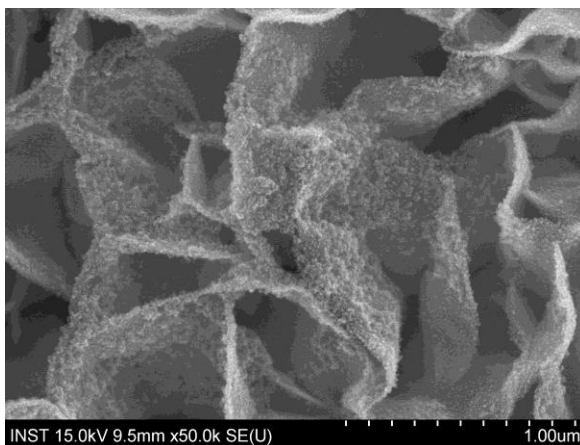


Fig. S3. SEM image of SnO₂ nanowall electrodes covered with TiO₂ particles.

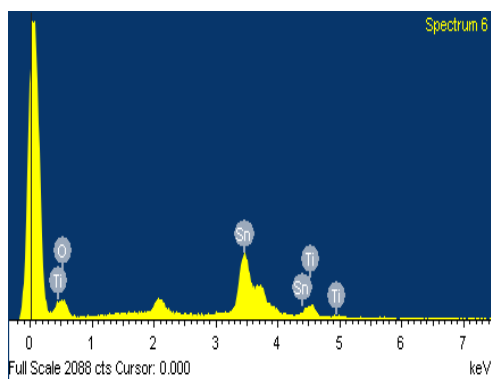


Fig. S4. EDX pattern of $\text{SnO}_2\text{-TiO}_2$ electrode

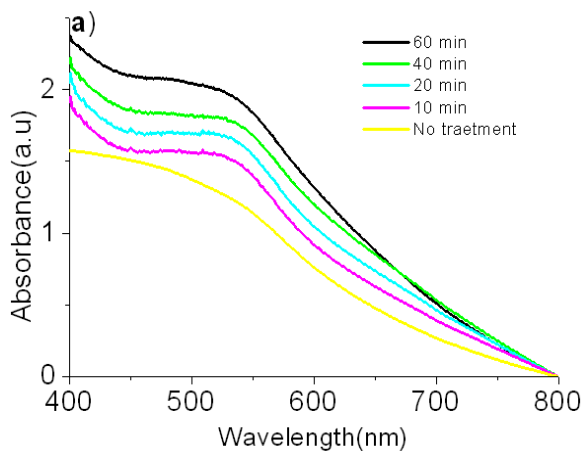


Fig. S5 UV-Visible absorption spectra of SnO_2 electrodes with various TiCl_4 treatment time.

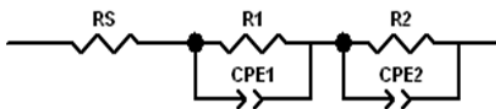


Fig. S6. Equivalent circuit used to fit impedance data.