**Supplementary Information**

# Efficient Flexible Dye-Sensitized Solar Cell with a Photoanode Consisting of $TiO_2$ Nanoparticles-Filled and SrO-Coated $TiO_2$ Nanotube Array

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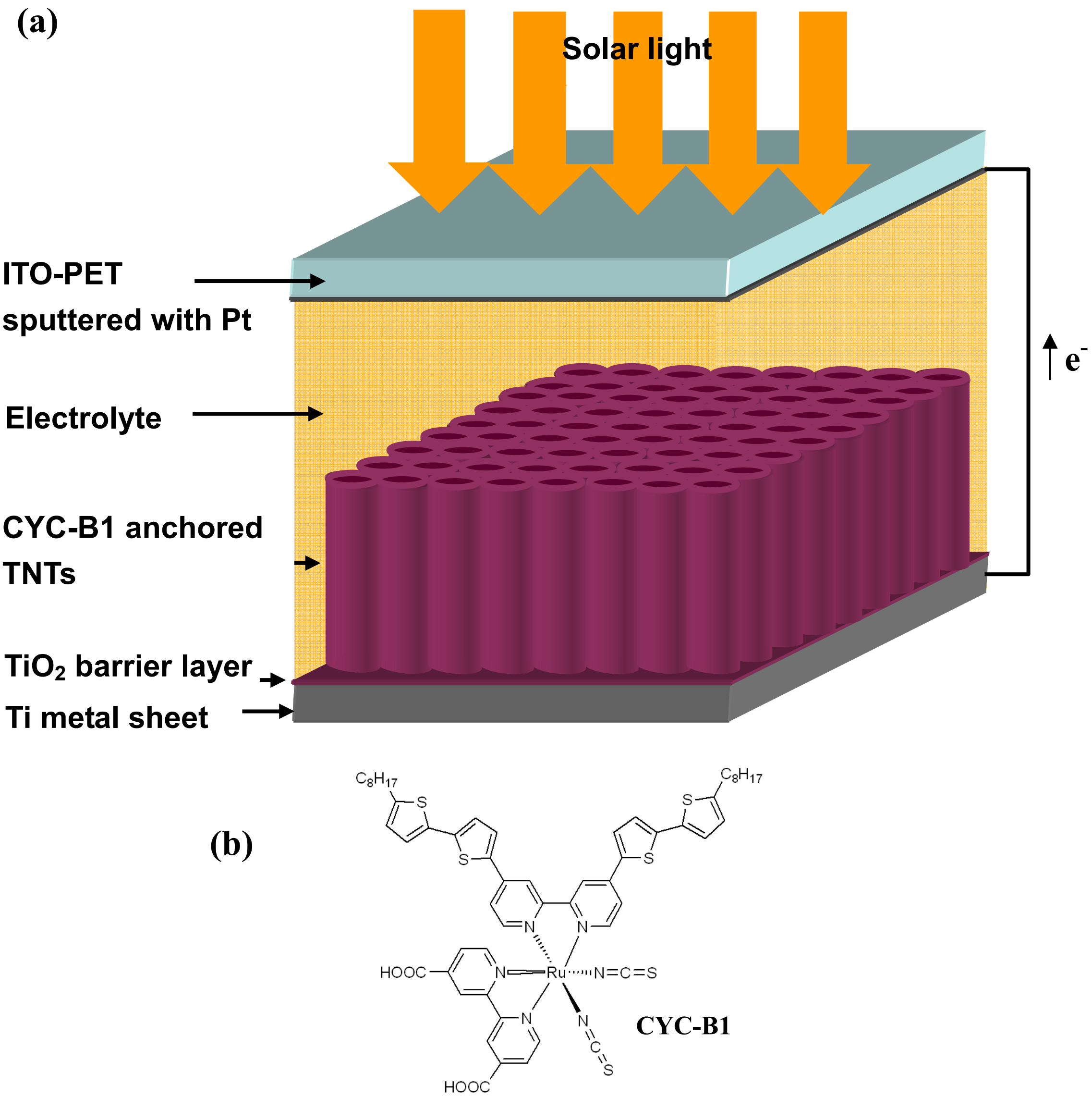


**Figure S1** (a) Schematic diagram of the back-illuminated DSSC with arrays of TNT as the photoanode, (b) chemical structure of CYC-B1 dye.

## Mott-Schottky-plots analysis

The Mott-Schottky-plots analysis predicts a linear relationship between the applied potential and the inverse square of capacitance ($1/C_{sc}^2$) arising from the space charge layer in a semiconductor.[1] Under biasing conditions where the semiconductor space charge region is in depletion, capacitance of the space charge region can be obtained by the following equation,

$$\frac{1}{C_{sc}^2} = \frac{2}{e\varepsilon_0\varepsilon N_\mathrm{d}}\left(-\Delta\varphi - \frac{kT}{e}\right) \tag{1}$$

here $e$ is electronic charge ($1.6\times10^{-19}$ C), $\varepsilon_0$ is the permittivity of free space ($8.86\times10^{-12}$ F/m), $\varepsilon$ is the dielectric constant of the $TiO_2$, $N_\mathrm{d}$ is dopant (donor or acceptor) concentration, $-\Delta\varphi$ is the difference between the applied potential and the flat-band potential ($E-E_\mathrm{fb}$), $k$ is the Boltzmann constant, and $T$ is the absolute temperature.[2] Considering the fact that the term of $kT/e$ is 0.026 eV at room temperature, which was insufficient to influence the original value, equation (1) may be briefly rewritten as follow,

$$\frac{1}{C_{sc}^2} = \frac{2}{e\varepsilon_0\varepsilon N_\mathrm{d}}\left(E - E_\mathrm{fb}\right) \tag{2}$$

The slope of $C_{sc}^2$ *vs.* $\Delta\varphi$ is inversely proportional to the effective donor or acceptor concentration in the semiconductor, and the flat-band potential can be determined by extrapolating $C_{sc}^2$ to 0.[3] The flat-band potentials of TNT, TNT-TNP, and TNT-TNP-SrO electrode estimated from Fig. 9 (in the article), were -0.69, -0.69 and -0.73 V *vs.* Ag/AgCl (in saturated KCl), respectively. The data shown that the $V_\mathrm{fb}$ of the TNT-TNP-SrO electrode is more negative to those of the other two electrodes by 0.04 V. $TiO_2$ coated with a layer of wide-band gap material, i.e., SrO, built an inherent potential barrier layer to block electron transfer from the conduction band or trap sites of the $TiO_2$ to the triiodide ions of the redox electrolyte. This barrier layer enabled TNT-TNP-SrO-DSSC to have a higher $V_{oc}$ than those of TNT-DSSC and TNT-TNP-DSSC. Using equation (2) with a linear fitting method and the physical constants of the $TiO_2$ material, the donor concentrations of TNT, TNT-TNP, and TNT-TNP-SrO electrodes were calculated to be $1.06\times10^{16}$, $1.38\times10^{16}$, and $2.21\times10^{16}$ $cm^{-3}$, respectively. The potential barrier of SrO retards the recombination of photo-injected electrons with $I_3^-$ ions and thereby increases the electron concentration in $TiO_2$, which also contributes for a higher $J_{sc}$ as observed in Fig. 7 (in the article). Benefited by a higher $V_{oc}$, $J_{sc}$, and FF, the TNT-TNP-SrO-DSSC showed the highest η amongst the three types of DSSC studied in this article.

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## Reference

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