Supporting Information

Densely Aligned Rutile TiO_2 Nanorod Arrays with High Surface Area for Efficient Dye-sensitized Solar Cells

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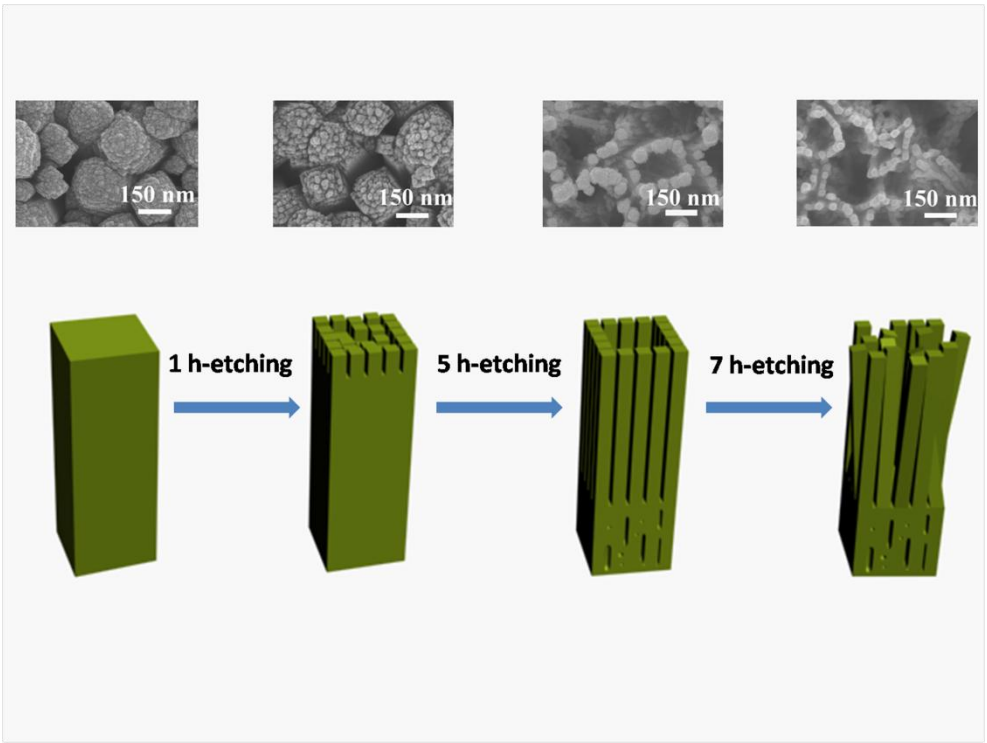

Scheme 1 Illustrations of formation process of the split rutile TiO_2 NRAs

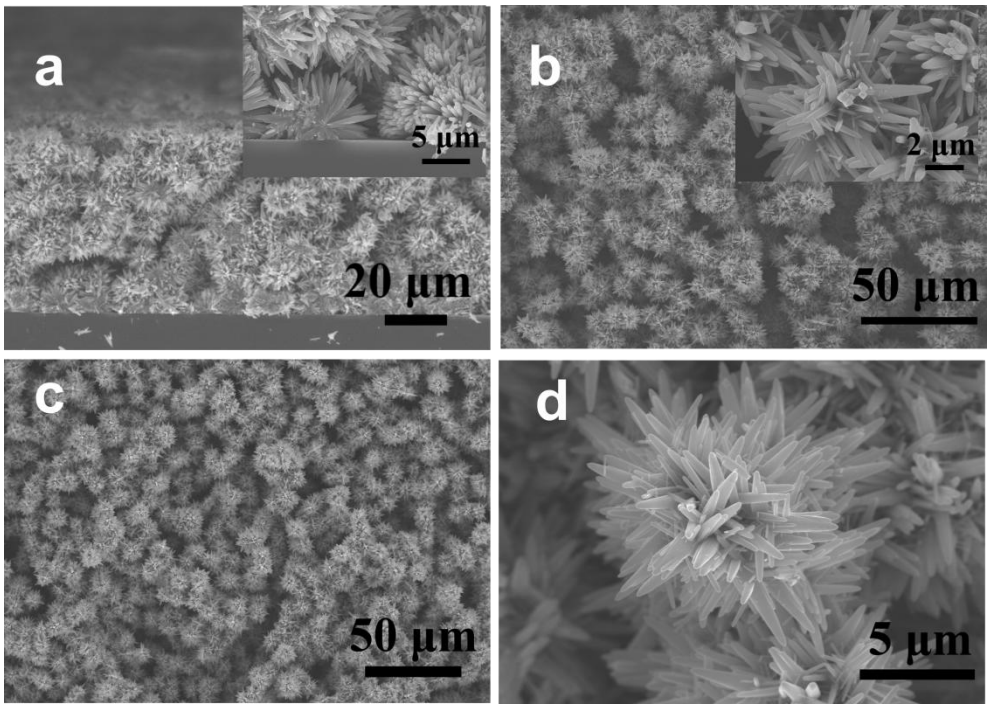

Fig. S1 SEM images of TiO_2 nanorods grown in a solution of 1 ml $TiCl_4$, 30 ml DI water and 30 ml concentrated hydrochloric acid at 150 ℃ on (a, b) glass side of the FTO substrates, and (c, d) inner surface of the Teflon-liner. The inset shows high-magnification images of TiO_2 nanorods grown on the glass side of FTO substrate.

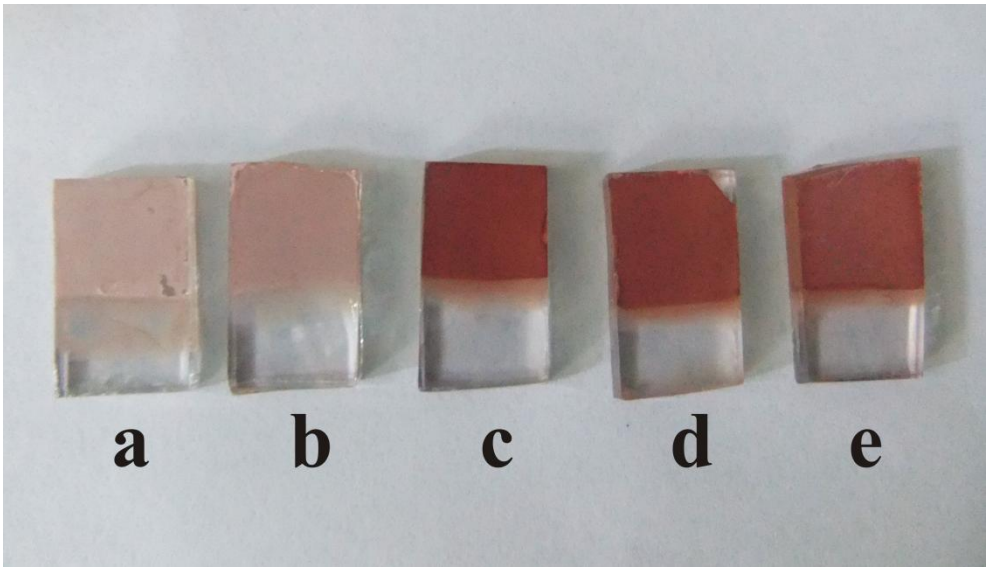

Fig. S2 The photograph of N719 dye sensitized 1-D rutile TiO_2 NRAs on FTO substrates. The TiO_2 NRA films were prepared using 1 ml $TiCl_4$, 30 ml DI water and 30 ml concentrated hydrochloric acid (36.0-38.0%) at 150 ℃ for 6 h, followed by etching treatment with different duration. (a) TiO_2 NRAs film without any etching treatment, (b) 1 h-etched TiO_2 NRAs, (c) 3 h-etched TiO_2 NRAs, (d) 5 h-etched TiO_2 NRAs, (e) 7 h-etched TiO_2 NRAs

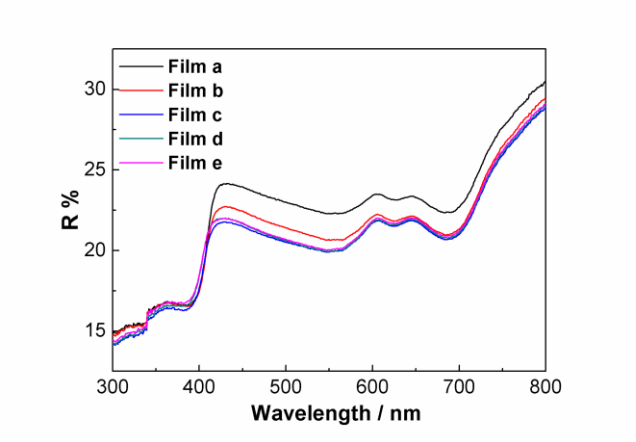

Fig. S3 Diffused reflectance spectra of TiO_2 NRAs film without dye-loading. Film a (TiO_2 NRAs film on FTO substrate without any etching treatment), Film b (1 h-etched TiO_2 NRAs film), Film c (3 h-etched TiO_2 NRAs film), Film d (5 h-etched TiO_2 NRAs film) and Film e (7 h-etched TiO_2 NRAs film). The films before dye adsorption are illuminated from the TiO_2 side with integrating sphere.

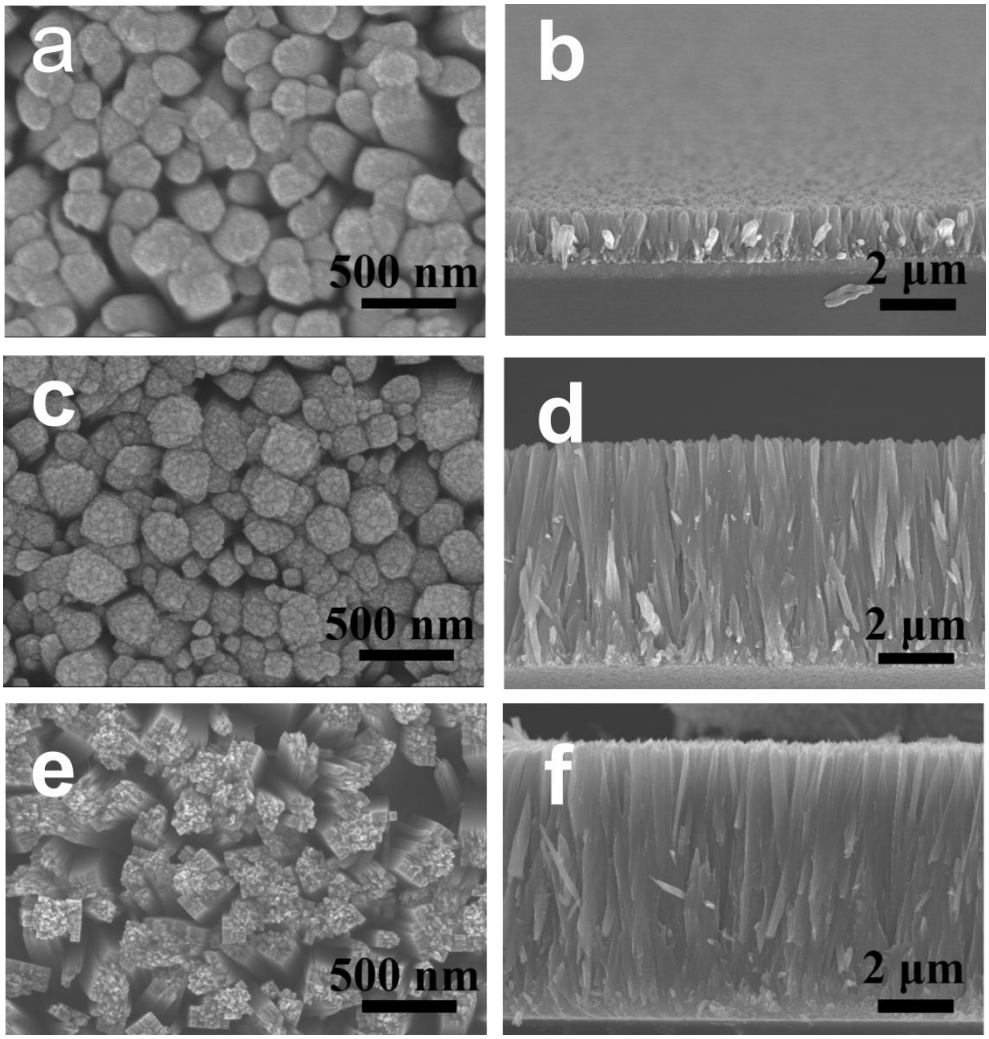

Fig. S4 FESEM images of the top and cross-sectional views of TiO_2 NRAs on FTO substrates using 1 ml $TiCl_4$, 30 ml DI water and 30 ml concentrated hydrochloric acid for 6 h at 120 ℃ (a, b), 150 ℃ (c, d) and 180 ℃ (e, f).

Fig. S4 shows the top and side views of FESEM images of TiO_2 NRAs fabricated by hydrothermal in a solution containing 1 ml $TiCl_4$, 30 ml DI water and 30 ml concentrated hydrochloric acid at different temperatures for 6 h. Obviously, highly oriented TiO_2 NRA films with thickness of approximate 1.5 μm, 6.2 μm and 7.5 μm for 120 ℃, 150 ℃ and 180 ℃ respectively were grown on FTO substrates. In addition, The TiO_2 NRA film prepared at 180 ℃for 6 h had poor adhesion to FTO substrate and was easily detached from FTO substrate.

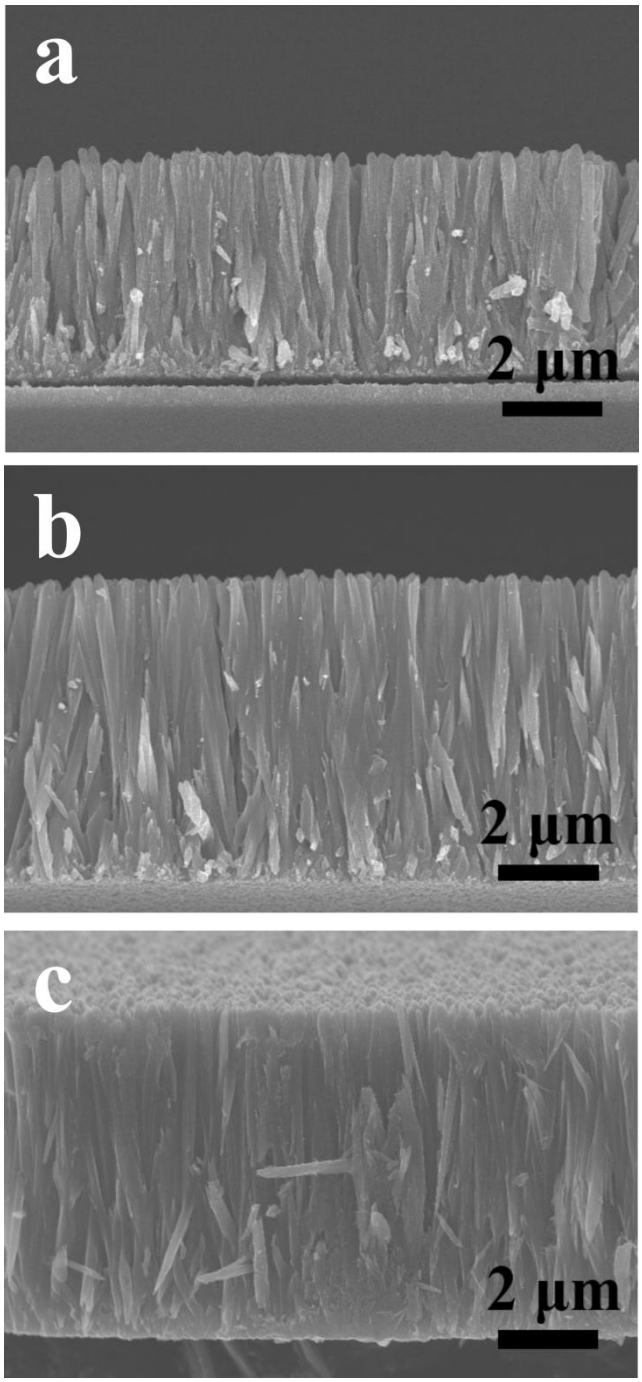

Fig. S5 FESEM images of the top and cross-sectional views of TiO_2 NRAs prepared by hydrothermal method using 1 ml $TiCl_4$, 30 ml DI water and 30 ml concentrated hydrochloric acid at 150 ℃ for (a) 4 h, (b) 6 h and (c) 8 h.The thickness of TiO_2 NRA films is 4.5 μm, 6.2 μm and 6.5 μm for 4 h, 6 h and 8 h, respectively.

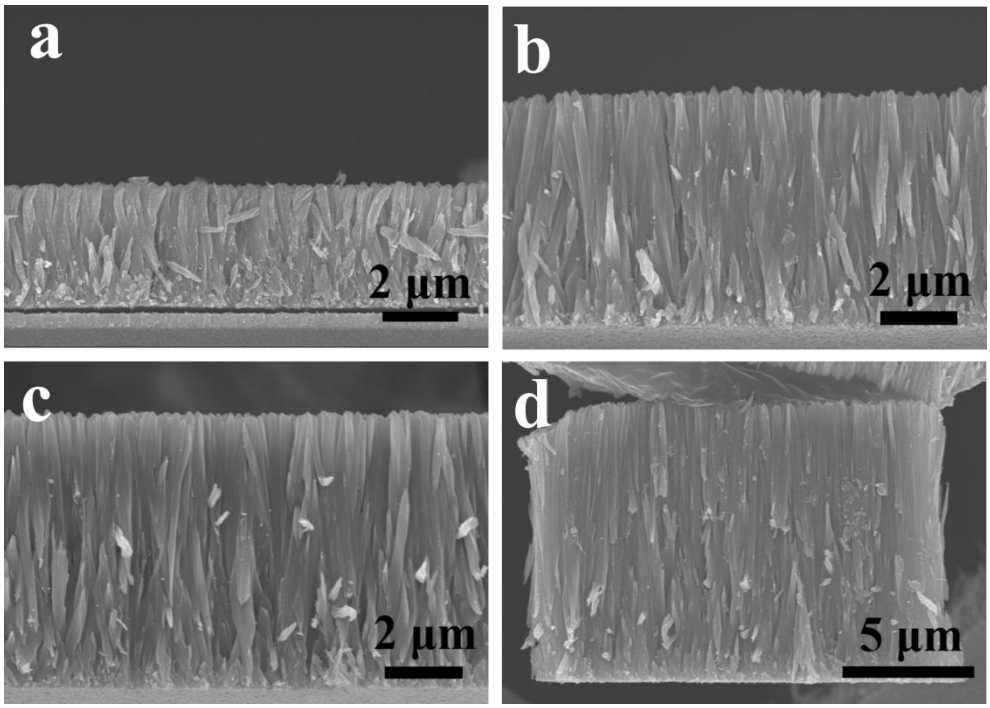

Fig. S6 FESEM images of the cross-sectional views of TiO_2 NRAs prepared by hydrothermal method using 30 ml DI water and 30 ml concentrated hydrochloric acid for 6 h with different amounts of $TiCl_4$. (a) 0.5 ml, (b) 1 ml, (c) 1.5 ml, (d) 2 ml.

As increasing Ti^{4+} concentration from 0.5 ml to 2ml and keeping hydrothermal temperature at 150 °C for 6 h, the as-prepared film thickness increased sharply from 3.25 μm to 10.3 μm. However, the 10.3-μm-thick film was automatically detached from FTO substrate immediately when the sample was dried in the air.

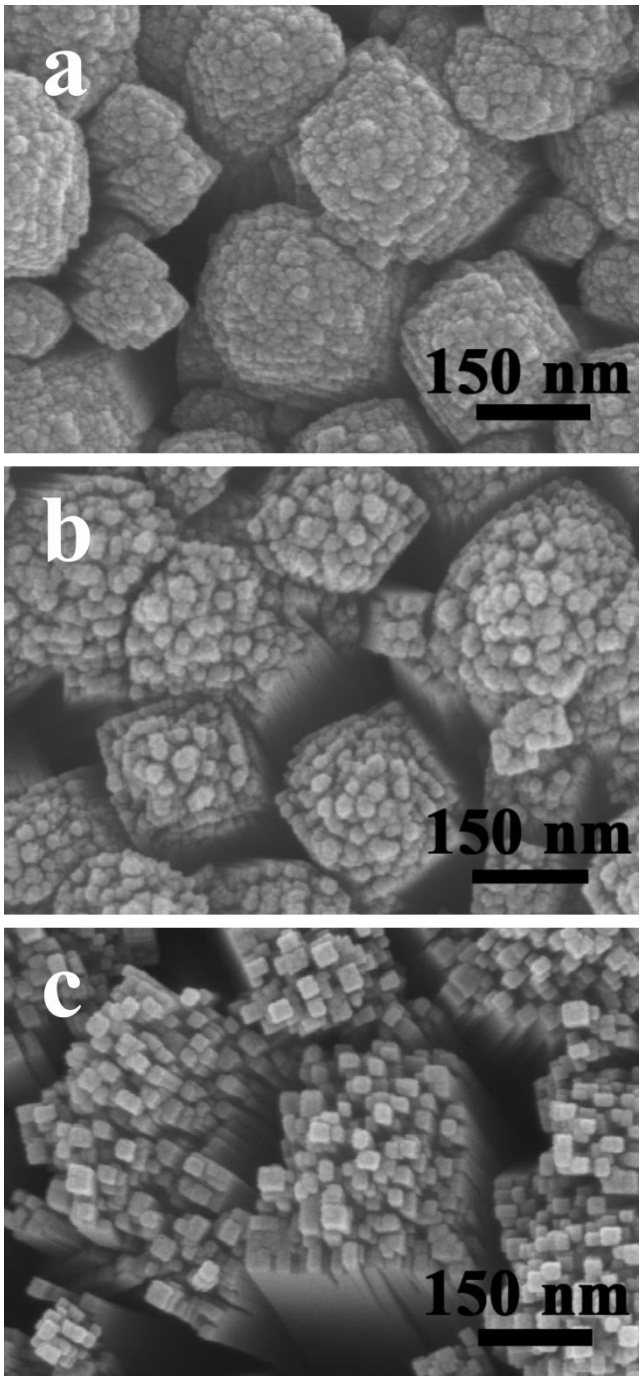

Fig. S7 FESEM images of the top views of TiO_2 NRAs prepared by hydrothermal using 1 ml $TiCl_4$, 30 ml DI water and 30 ml concentrated hydrochloric acid for 6 h (a) and 48 h (c). Image (b) is the top view of 1-h-etched TiO_2 NRAs.