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A facile way to fabricate highly efficient photoelectrodes with chemical sintered scattering layers for dye-sensitized solar cells

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S1. IPCE performance of DSSCs with different structure and thickness of nc-TiO_2 layers in photoelectrodes

Figure S1 (a) shows that the IPCE performance of DSSCs with 5 μm thickness of the single second nc-TiO_2 layer prepared with paste B containing different amount of $NH_3 \cdot H_2O$ in the photoelectrodes is poorer than that of the DSSC with the same thickness of the single first nc-TiO_2 layer prepared with paste A in the photoelectrode. And the performance of the former ones is gradually decreased with the increased additional amount of $NH_3 \cdot H_2O$ in paste B. Figure S1 (b) shows that IPCE performance of DSSCs with bilayer structure photoelectrodes is greatly enhanced compared with the single first nc-TiO_2 layer in photoelectrode. The change tendency of IPCE performance of these samples is quite different from that of the results shown in Figure S1 (a) by going with the increased additional amount of $NH_3 \cdot H_2O$ in paste B. Namely, the IPCE performance of these samples is increased to a maximum value when the additional amount of $NH_3 \cdot H_2O$ in paste B attained to 2.0 g then decreased while that of the former ones is gradually decreased. Figure S2 shows that IPCE performance of DSSCs with bilayer structure photoelectrodes can attain to a higher value with the further increased thickness of the second nc-TiO_2 layer prepared with 2.0 g $NH_3 \cdot H_2O$ in paste B to 12 μm.

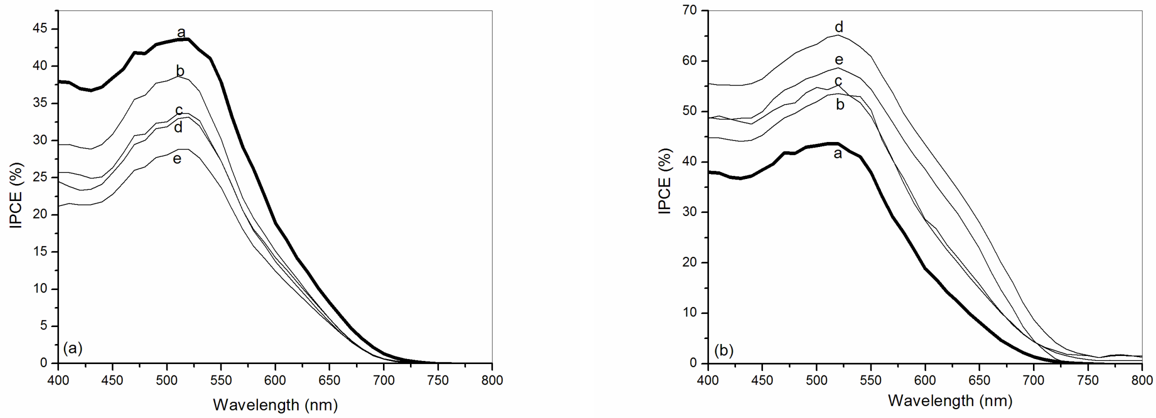

Fig. S1 IPCE spectra of DSSCs with different structure and thickness of nc-TiO_2 layer in photoelectrodes. (a) the single nc-TiO_2 layer of ca. 5 μm thickness prepared with paste A and B, (b) the bilayer structure with the second nc-TiO_2 layer of ca. 5 μm thickness prepared with paste B on the first ca. 5 μm nc-TiO_2 layer prepared with paste A. The letter of a in the Figures marks as the single nc-TiO_2 layer prepared with paste A, and the letters of b, c, d, e in the figures mark as the nc-TiO_2 layers prepared with paste B containing 1.5 g, 1.75 g, 2.0 g and 2.25 g $NH_3 \cdot H_2O$, respectively.

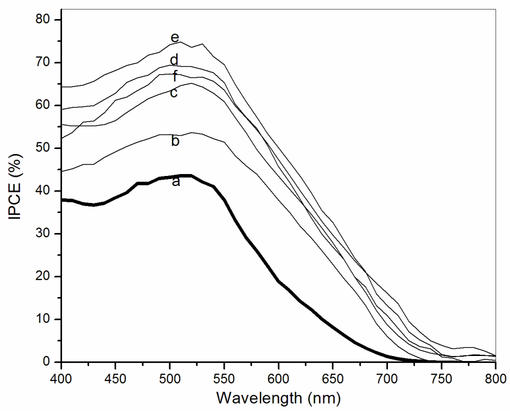

Fig. S2 IPCE spectra of DSSCs with the different thickness of the second nc-TiO_2 layer prepared with paste B containing 2.0 g $NH_3 \cdot H_2O$ in photoelectrodes. The letter of a in the Figure marks as the single nc-TiO_2 layer of ca. 5 μm thickness prepared with paste A, and the letters of b, c, d, e, f mark as the second nc-TiO_2 layer of ca. 3 μm, 5 μm, 9 μm, 12 μm, 15 μm thickness on the 5 μm first nc-TiO_2 layer in photoelectrodes, respectively.

S2. UV-vis absorption and diffused reflection spectra of photoelectrodes with different structure and thickness of nc-TiO_2 layers

Figure S3 (a) shows that the absorbance of dye desorbed from the 5 μm-thick nc-TiO_2 film prepared with paste B is lower than that of the film prepared with paste A. And the absorbance of dye desorbed from the film prepared with the increased additional amount of $NH_3 \cdot H_2O$ in paste B decreases gradually. While the nc-TiO_2 films with bilayer structure by adding the second nc-TiO_2 layer on the first nc-TiO_2 layer or with the increased thickness of the second nc-TiO_2 layer both can enhance the dye coated amount as shown in Figure S3 (b) and (c).

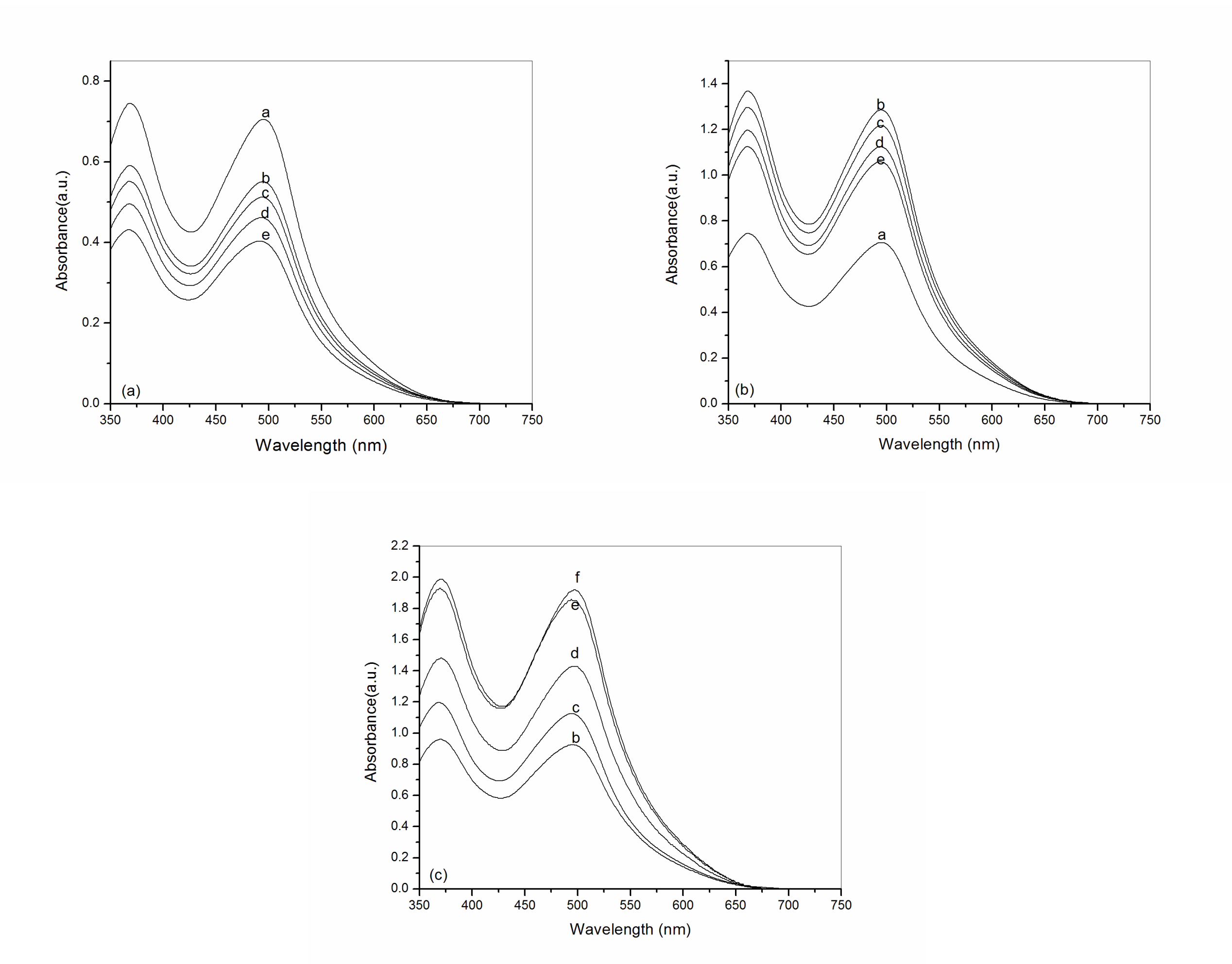

Fig. S3 UV-vis absorption spectra of dye coated on, 5 μm-thick nc-TiO_2 film (a), bilayer nc-TiO_2 film with 5μm-thick of the first nc-TiO_2 layer prepared with paste A and 5μm-thick of the second nc-TiO_2 layer prepared with paste B (b), and increased thickness of the second nc-TiO_2 layer prepared with paste B containing 2.0 g $NH_3{\cdot}H_2O$ (c). The letters in the Figures of (a) and (b) mark as the same samples as shown in Figure S1, and the letters in the Figure of (c) mark as the same samples as shown in Figure S2.

Figure S4 (a) shows that the reflection of 5 μm-thick nc-TiO_2 film prepared with paste B is much higher than that of the nc-TiO_2 film prepared with paste A. And the reflectance of the film prepared with the increased additional amount of $NH_3{\cdot}H_2O$ in paste B increases gradually. Increasing the thickness of the film either through the addition of the second nc-TiO_2 layer on the first nc-TiO_2 layer or preparation of the thicker second nc-TiO_2 layer with paste B containing 2.0 g $NH_3{\cdot}H_2O$ can further enhance the reflecting ability of the film.

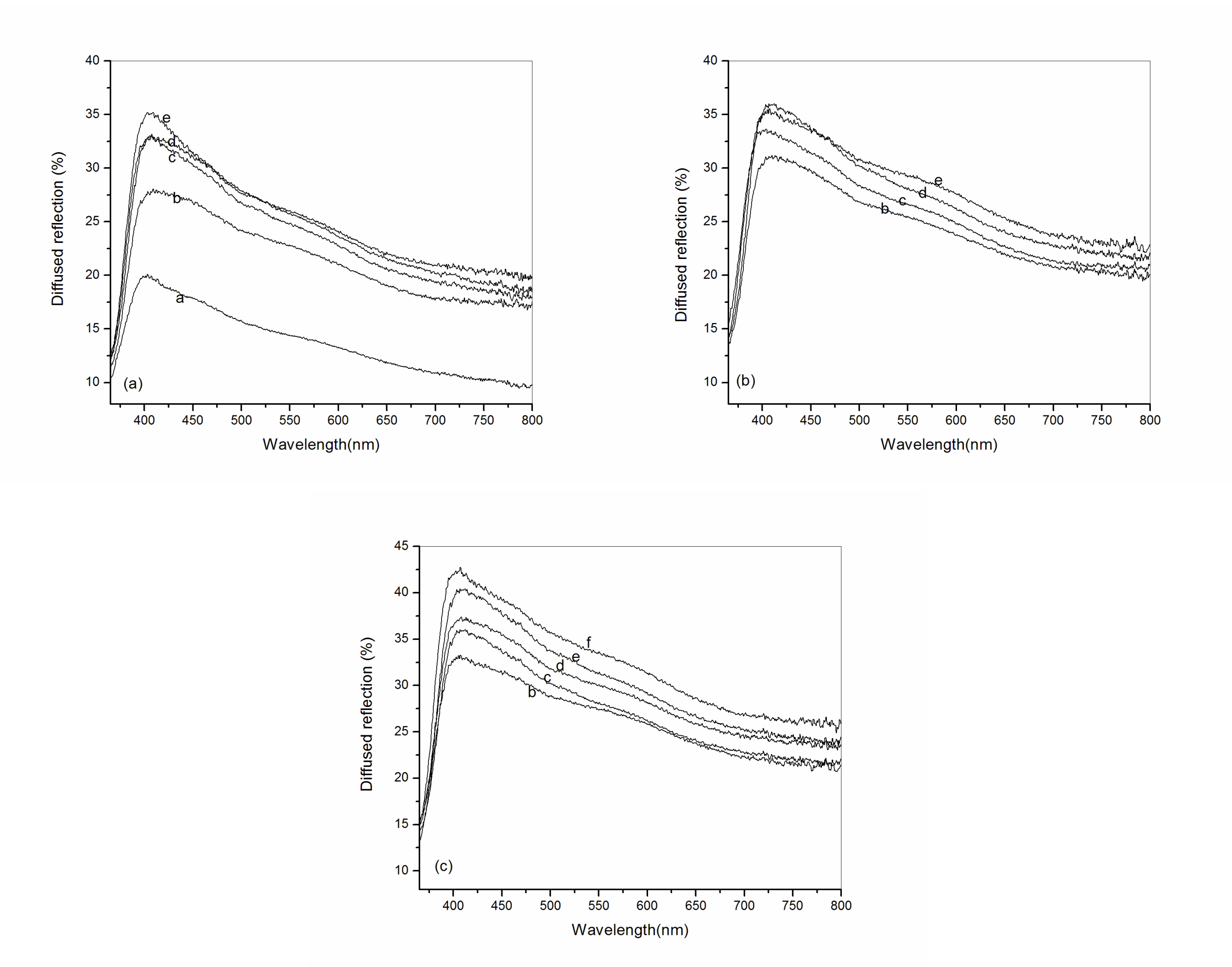

Fig. S4 UV-vis diffused reflection spectra of nc-TiO_2 film without absorbed dye, 5 μm-thick nc-TiO_2 film (a), bilayer nc-TiO_2 film with 5μm-thick of the first nc-TiO_2 layer prepared with paste A and 5μm-thick of the second nc-TiO_2 layer prepared with paste B (b), and increased thickness of the second nc-TiO_2 layer prepared with paste B containing 2.0 g $NH_3 \cdot H_2O$ (c). The letters in the Figures of (a) and (b) mark as the same samples as shown in Figure S1, and the letters in the Figure of (c) mark as the same samples as shown in Figure S2.

S3. Photovoltaic performance of DSSCs with different structure and thickness of nc-TiO_2 layer in photoelectrodes

Figure S5 (a) shows that photovoltaic performance of DSSCs with 5 μm-thick nc-TiO_2 film prepared with paste B is lower than that of the film prepared with paste A. And the DSSCs with nc-TiO_2 film prepared with the increased amount of $NH_3 \cdot H_2O$ in paste B causes the decreased photovoltaic performance. While DSSCs containing the bilayer structure or with the increased thickness of the second nc-TiO_2 layer both can enhance photovoltaic performance as shown in Figure S5 (b) and (c).

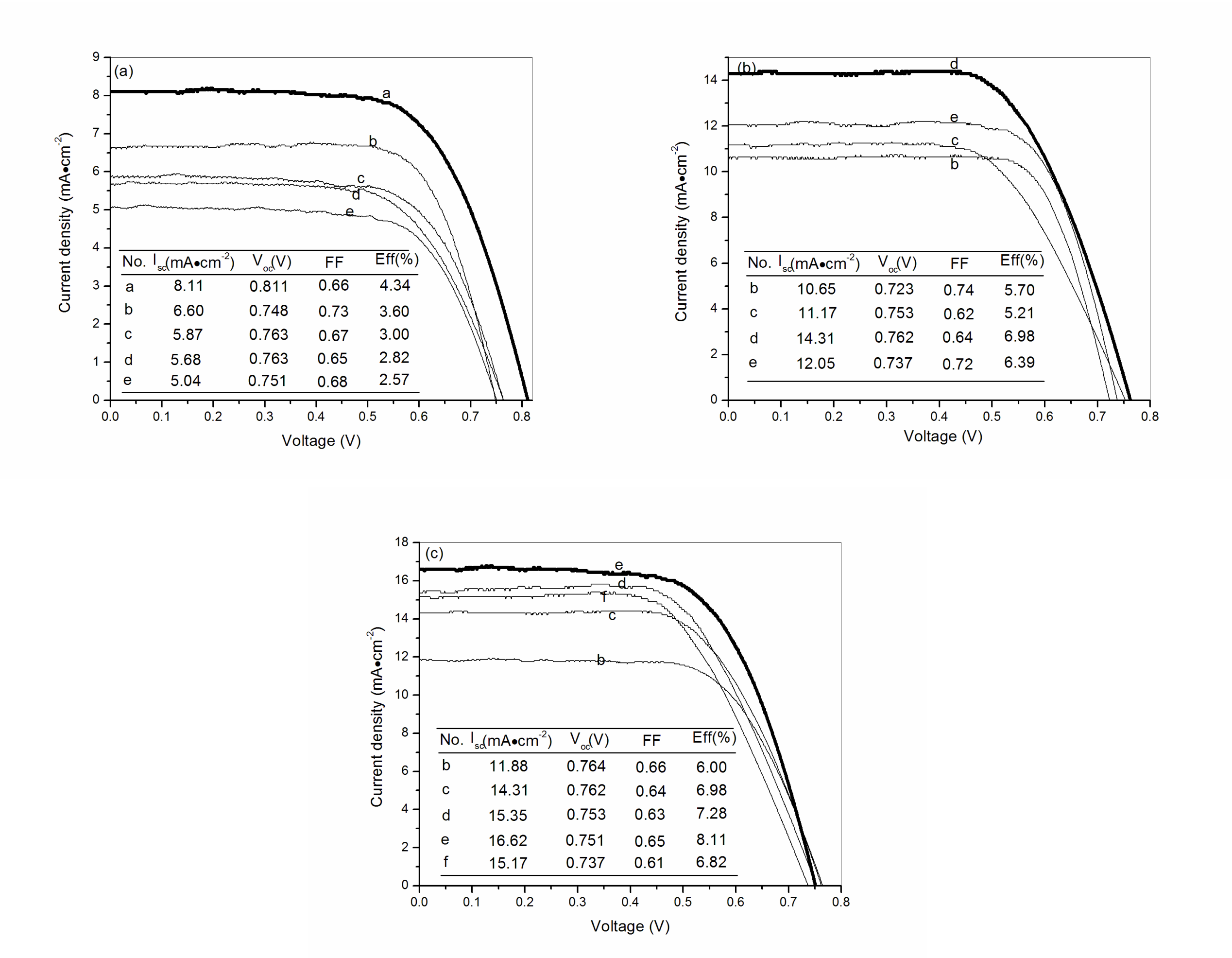

Fig. S5 Photovoltaic performance of DSSCs, 5 μm-thick nc-TiO_2 film (a), bilayer nc-TiO_2 film with 5μm-thick of the first nc-TiO_2 layer prepared with paste A and 5μm-thick of the second nc-TiO_2 layer prepared with paste B (b), and increased thickness of the second nc-TiO_2 layer prepared with paste B containing 2.0 g $NH_3 \cdot H_2O$ (c). The letters in the Figures of (a) and (b) mark as the same samples as shown in Figure S1, and the letters in the Figure of (c) mark as the same samples as shown in Figure S2.