Supporting information:

Strontium Titanate Nanoparticles as Photoanode for CdS Quantum Dot Sensitized Solar Cells

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Experimental part:

120 nm $SrTiO_3$ nanoparticles,

30 mL boiling deionized water had been purged and degassed with nitrogen for 30 minutes. 0.01 mol strontium hydroxide (97%, Alfa) was added in the above water solution. 0.01 mol titanium dioxide (P25), 10 mL deionized water and appropriate amount of potassium hydroxide were mixed together to get a colloidal suspension with pH = 13. 0.2 g PVP (k90) was added into the mixture solution of the strontium hydroxide solution and the titanium dioxide suspension with vigorous stirring. The obtained suspension was transferred to Teflon-lined autoclave after 12 h stirring followed by keeping the autoclave at 190 °C for 12 h. Then the products were collected by centrifugation at 7000 rpm for 20 minutes, filtering several times with diluted nitric acid, and drying in air at 90 ℃for 24 h. Finally the powders of $SrTiO_3$ were obtained.

70 nm $SrTiO_3$ nanoparticles,

Titanium hydroxide was obtained by the mixing of tetrabutyl titanate $Ti(C_4H_9O)_4$ (0.01mol) and ammonia solution (20ml) in ethanol. In order to remove NH^{4+} and ethanol, the resulting titanium hydroxide was filtered and washed with deionized water three times and dispersed in deionized water. $Sr(NO_3)_2$(0.0105 mol) , KOH (0.05mol), and PVA (0.064g) were added to the above purified titanium hydroxide solution with vigorous stirring. Finally, the suspension was transferred into a 50 mL Teflon-lined autoclave. The autoclave was kept at 200 ^oC for 12 h. Filtering and

washing with diluted nitric acid and deionized water were employed to eliminate the byproducts of $SrCO_3$. The powders of $SrTiO_3$ were collected after the resultant products were dried in air at 90 ℃ for 24 h.

30 nm $SrTiO_3$ nanoparticles,

An aqueous solution with pH=13.5 was prepared by mixing titaniumbis (ammonium lactate) dihydroxide (TALH) (0.01 mol) and strontium hydroxide octahydrate (0.01 mol) with vigorous stirring. Oleic acid (3 ml) were added to the above solution followed by transferring the resulting solution into an autoclave, and the autoclave was kept in an oven at 200 ℃ for 12 h. The products were obtained from the resultant mixture by centrifugation. Finally 30 nm $SrTiO_3$ nanoparticles were collected by drying in air at 90 ℃ for 24 h .

Preparation of TiO_2/$SrTiO_3$ composite paste

According to the fabrication scheme in Fig. S1, the preparation process of TiO_2/$SrTiO_3$ composite paste is described; at each step, liquids were added drop by drop into an alumina mortar with a diameter of 20 cm. The condition was in the ambient air at room temperature (25℃). The original amount of six ratios TiO_2/$SrTiO_3$ composites were as follows: (1) 6 g TiO_2+0 g $SrTiO_3$; (2) 5.4 g TiO_2+ 0.6 g $SrTiO_3$; (3) 4.8 g TiO_2+ 1.2 g $SrTiO_3$; (4) 3 g TiO_2 + 3 g $SrTiO_3$; (5) 1.2 g TiO_2+ 4.8 g $SrTiO_3$; (6) 0 g TiO_2+6 g $SrTiO_3$. The TiO_2/$SrTiO_3$ dispersions in the mortar were transferred to a beaker and stirred with a 4 cm long magnet tip at 300 rpm. The

ultrasonic homogenisation was performed with using a sonicator. Anhydrous terpineol (Fluka) and the mixture solution of ethyl celluloses (SIGMA) in ethanol were added, followed by stirring and sonication. Finally，The pastes were finalised with a three-roller-mill grinder (EXAKT).

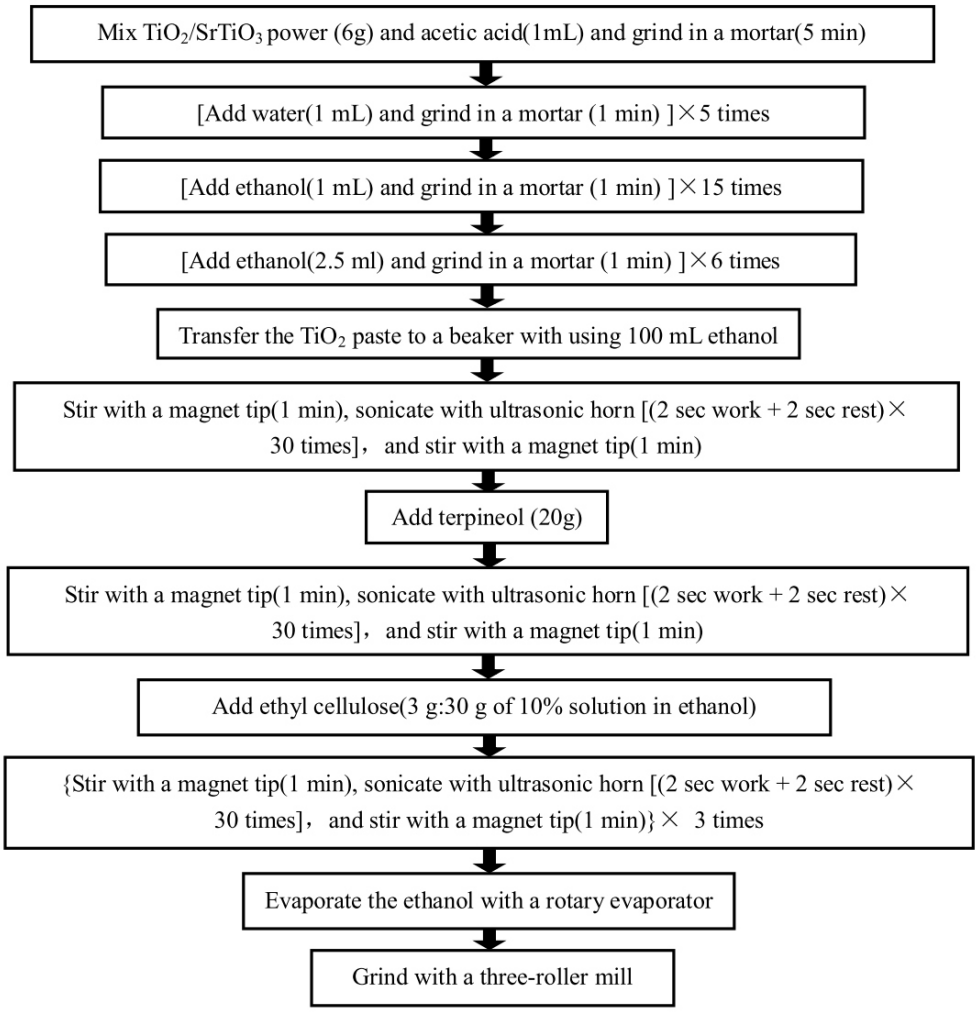

Fig. S1. Fabrication scheme of TiO_2/$SrTiO_3$ composite paste

The thickness characterization of the oxide photoanode

To better characterize $SrTiO_3$ photoanode , we conducted the thickness of the oxide photoanode by cross-section SEM（scanning electron microscope）measurements .The thickness of the oxide photoanode is approximately 4um, more accurate to say, 4.063um.

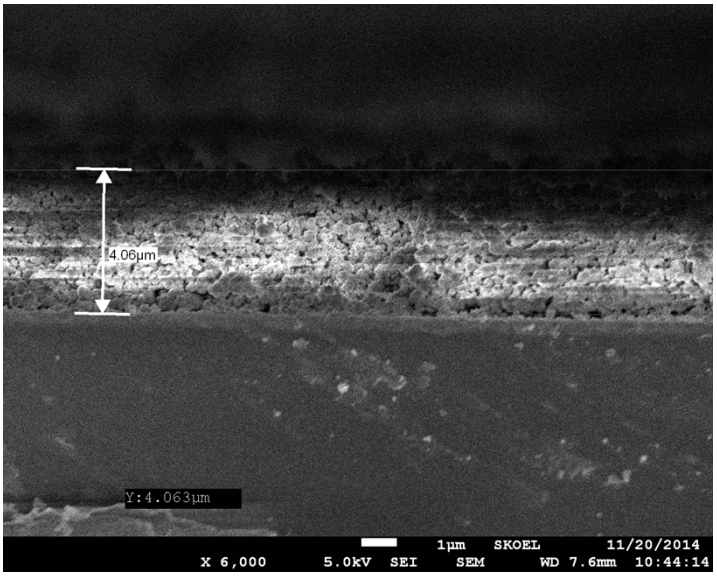

Fig. S2. The thickness of the oxide photoanode measured by SEM(cross-section).

The Cd^{2+} concentration test with different ratio of TiO_2/$SrTiO_3$ composites as photoanode in QDSSCs.

For precise measurement, we have designed another direct experiment for detecting the adsorption ability of $SrTiO_3$ compared to TiO_2 though measuring the amount of cadmium ions. Specific embodiments are as follows: Measuring the amount of adsorption of quantum dots, that is, determination of the amount of Cd^{2+}, Our idea is to measure the amount of cadmium ions, and finally we can determine the amount of CdS, and finally the same amount of adsorption can be determined.

We put the oxide photoanode which through same SLIAR preparation process into 50mL dilute nitric acid for two hours individually, finally CdS was dissolved in dilute nitric acid and Cd^{2+} was produced, a VA Computrace(TEA 4000) was used to detect the concentration of Cd^{2+}，It can be observed that the concentration of Cd^{2+} increases when the ratio of TiO_2 to $SrTiO_3$ increases. The concentration of $Cd^{2+}$by $SrTiO_3$ is lower compared to that of TiO_2, which indicates that $SrTiO_3$ has lower adsorption ability. Specific changes in the concentration can be derived as follows (Table.S3) according to the ion concentration test.

Architecture (%)	Average Cd^{2+} concentration（ug/L）
TiO_2 (100%) $SrTiO_3$ (0%)	69.45
TiO_2 (90%) $SrTiO_3$ (10%)	67.24
TiO_2 (80%) $SrTiO_3$ (20%)	66.07
TiO_2 (50%) $SrTiO_3$ (50%)	65.96
TiO_2 (20%) $SrTiO_3$ (80%)	62.75
TiO_2 (0%) $SrTiO_3$ (100%)	59.73

Table. S1. The concentration of Cd^{2+} with different ratio of $TiO_2/SrTiO_3$ composites.