Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

Supporting Information for the manuscript

Photocatalytic Oxidation of Methane over $SrCO_3$ Decorated $SrTiO_3$ Nanocatalysts via a Synergistic Effect

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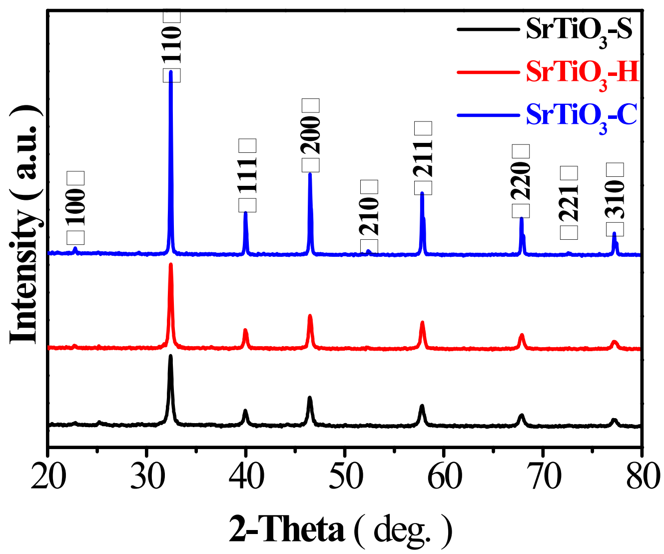


Fig. S1. The XRD patterns of $SrTiO_3$ samples prepared by different methods.

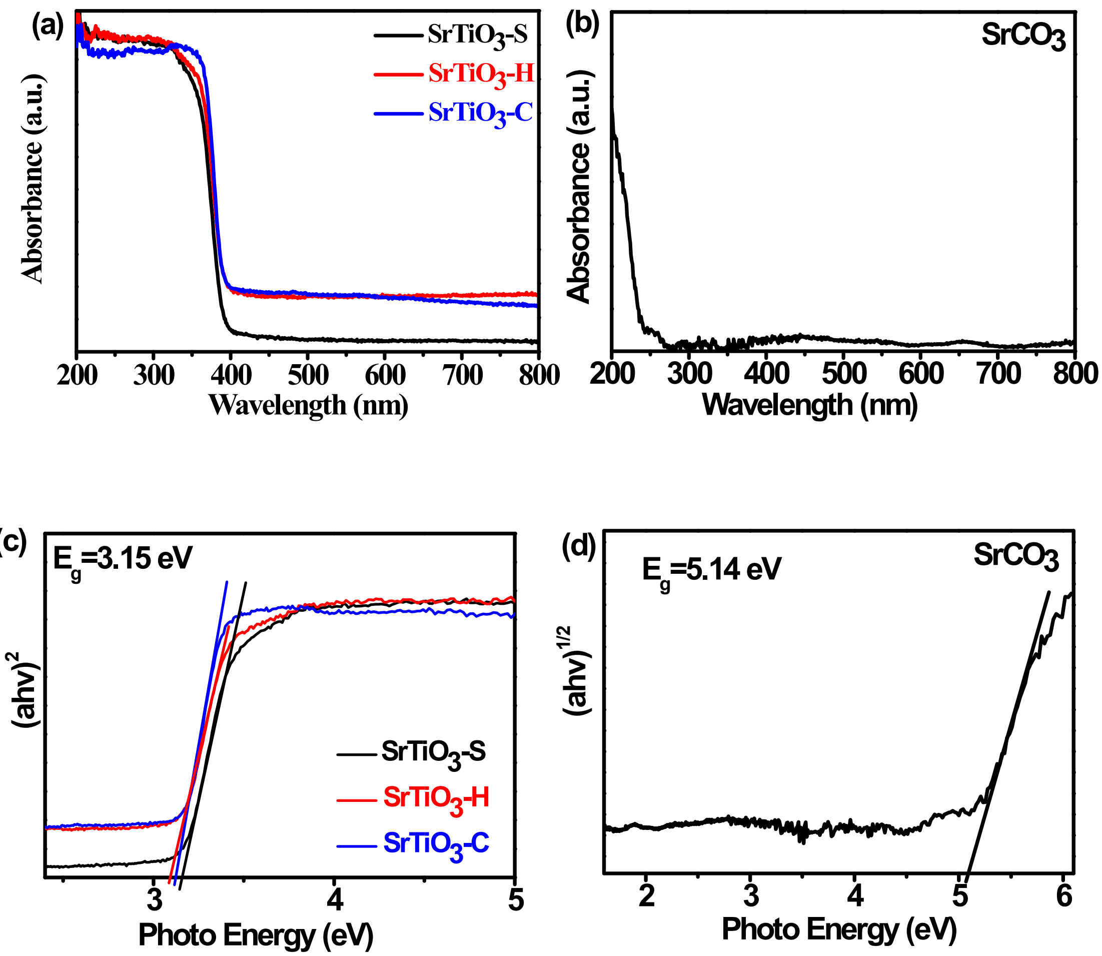
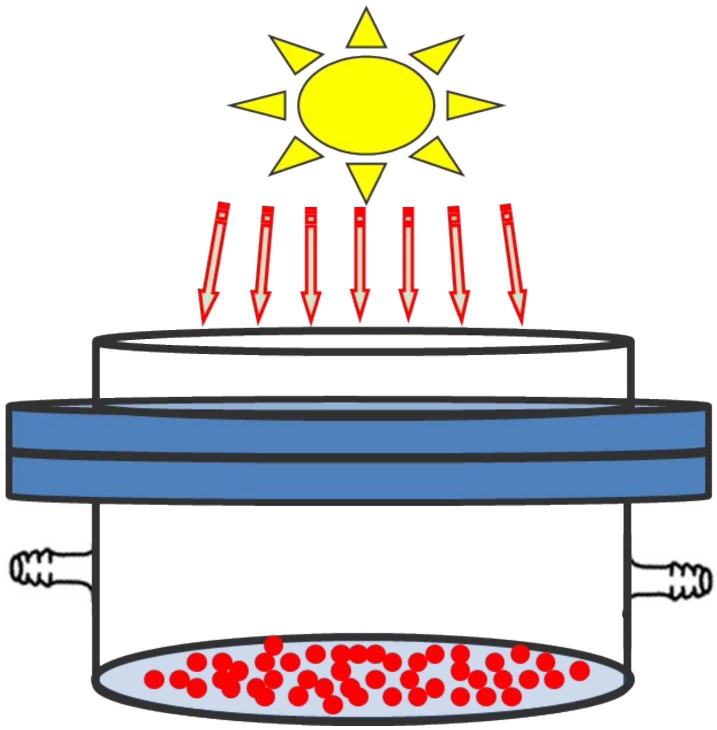


Fig. S2. Ultraviolet–visible diffusive reflectance spectra of: a, the $SrTiO_3$ samples. b, $SrCO_3$ powder; The plots of transformed Kubelka-Munk Function *versus* the energy of light of: c, the $SrTiO_3$samples. d, $SrCO_3$.

Table S1. Surface areas and particles size of the $SrTiO_3$ samples prepared by different methods.

Samples	Surface area (m^2/g)	Particle size (nm)
$SrTiO_3$-S	43.15	~25
$SrTiO_3$-H	32.68	~30
$SrTiO_3$-C	5.46	~400

(a)



(b)

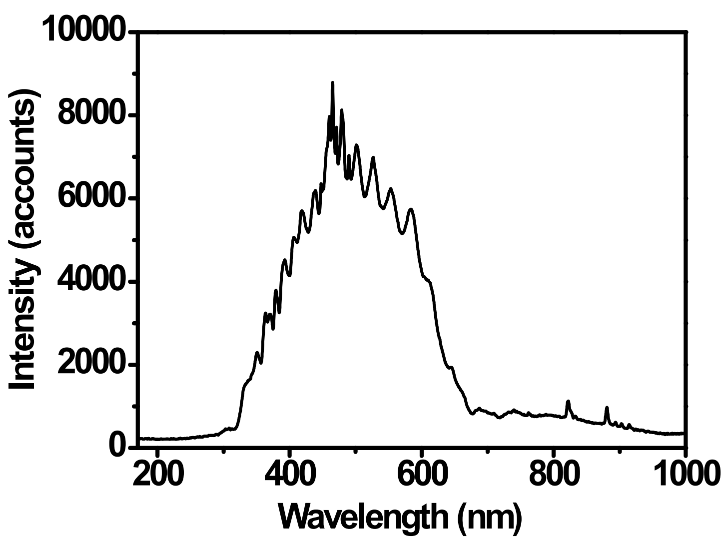


Fig. S3. Experimental conditions of CH_4 photooxidation. a, Setup of the CH_4 photooxidation. b, The spectrum of the Xe lamp.

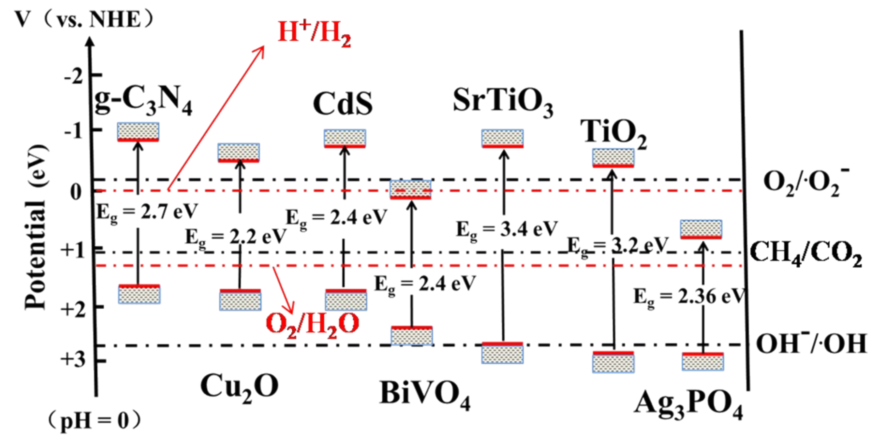


Fig. S4. The band edge diagrams of some known photoactive semiconductors.

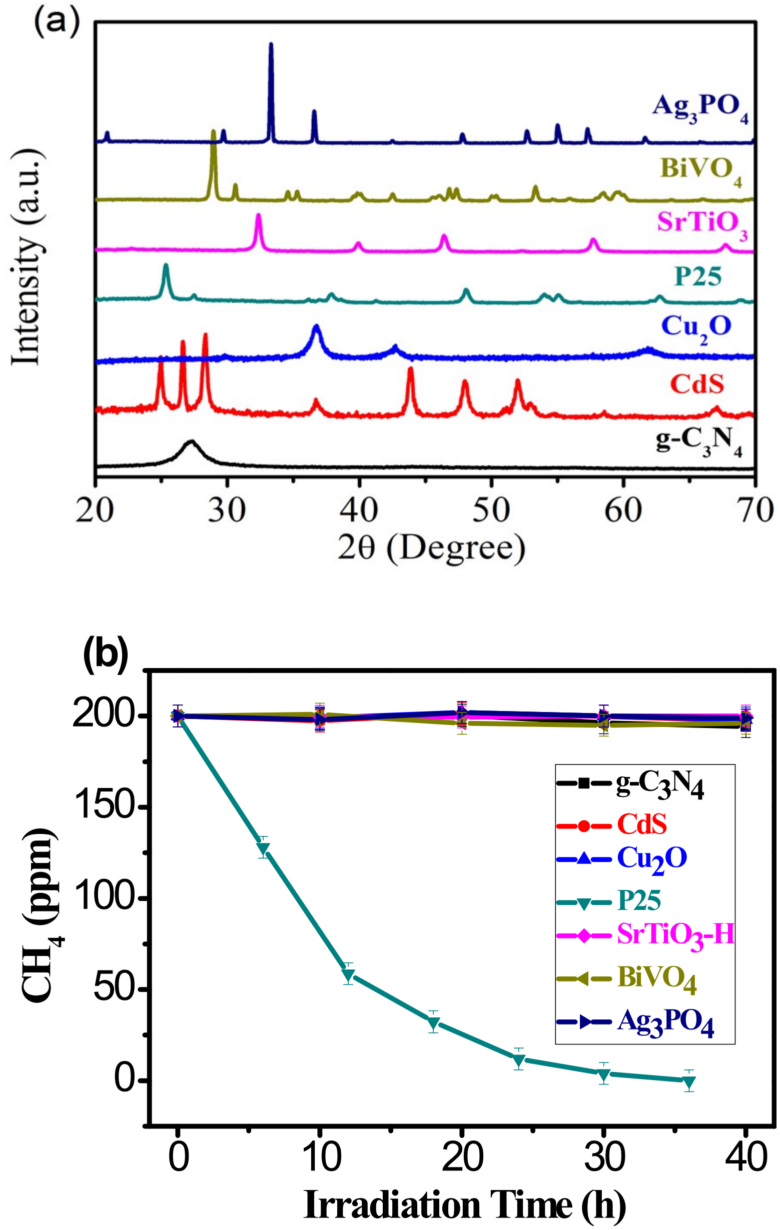


Fig. S5. Phase identification and methane photooxidation properties of some typical semiconductors under simulated solar light illumination. a, Room temperature XRD patterns. b, Time course of CH_4 photo-oxidation.

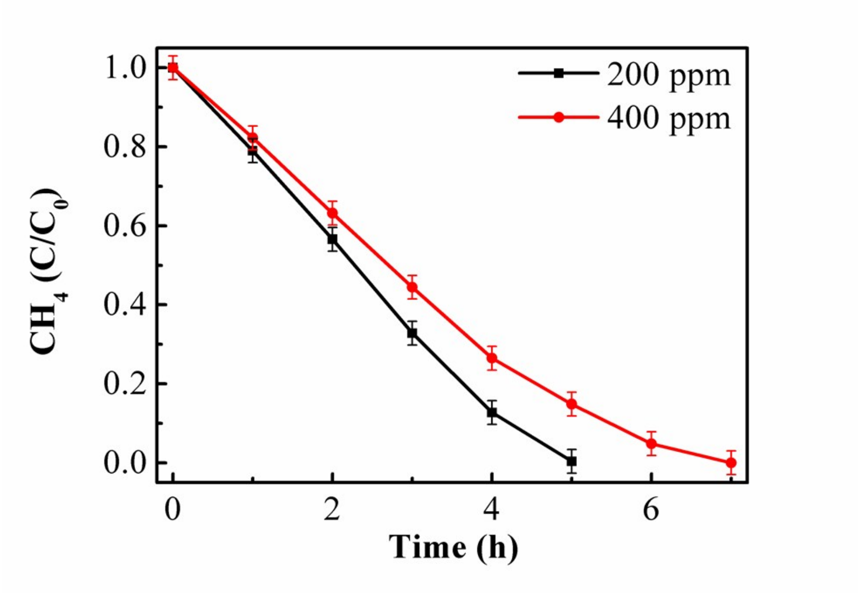


Fig. S6. Time course of CH_4 photooxidation over the $SrTiO_3$-S samples under simulated solar light illumination.

Turnover number calculations

Take reaction formula: $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$, the number of electrons gain and loss in the reaction is $8 \cdot e^{-1}$. We assume that all electrons are excited by light. The amount of substance of 5 mL CH_4: $n_1 = 5mL/(22.4L \cdot mol^{-1}) = 2.232 \times 10^{-4}$ *mol*; The total amount of substance of electrons gain and loss in the photooxidation of 5 mL CH_4 : $n_2 = 8 \times 2.232 \times 10^{-4}$ *mol* $= 1.7857 \times 10^{-3}$ *mol* ; For the 0.2 g $SrTiO_3$ samples：$n_3 = 0.2g/(183.49g \cdot mol^{-1}) = 1.09 \times 10^{-3}$ *mol*; The Turnover number $n = (1.7857 \times 10^{-3}$ mol$)/(1.09 \times 10^{-3}$ mol$) = 1.64$.

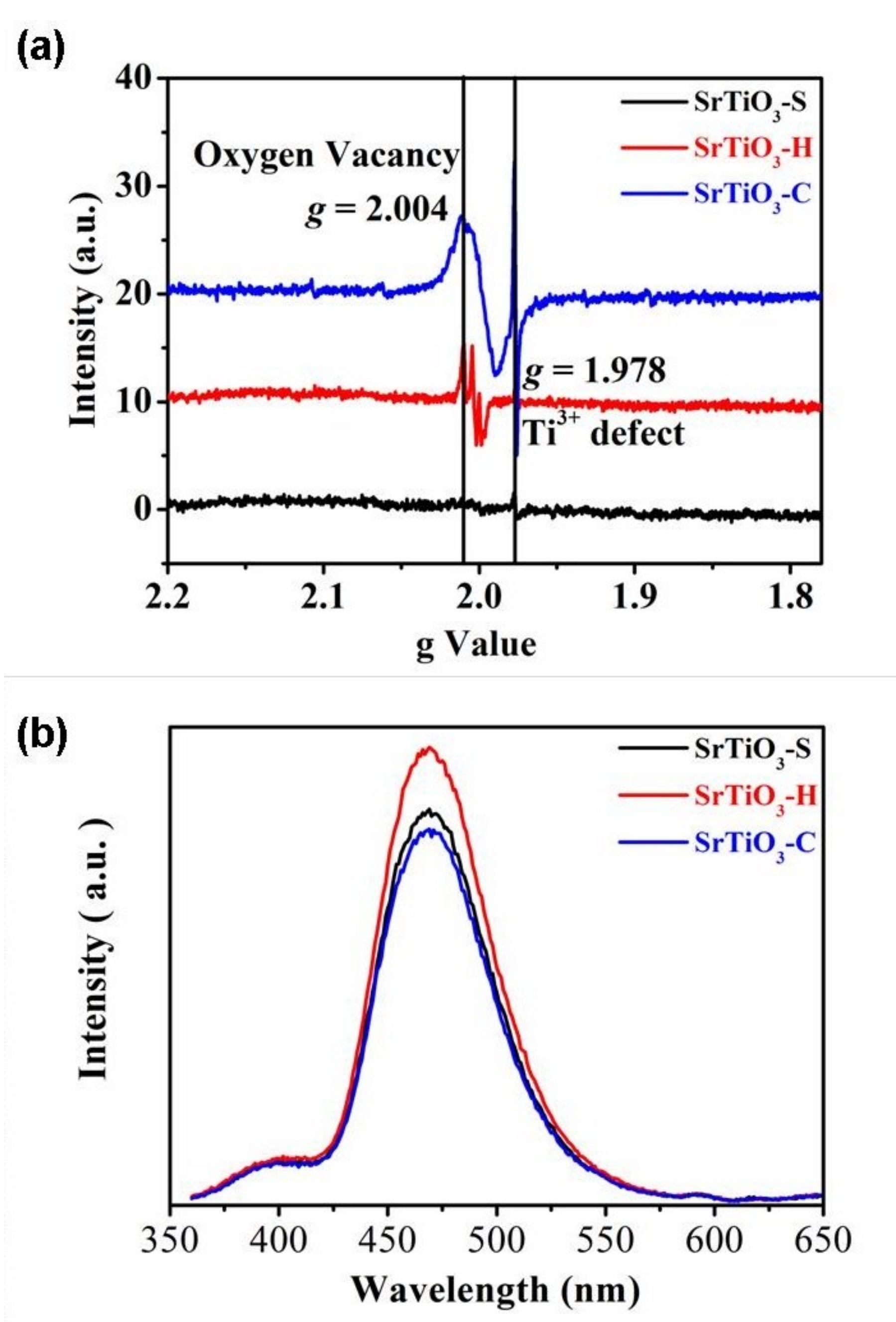


Fig. S7. Defects analysis of the as-prepared $SrTiO_3$ samples. a, EPR spectra. b, PL spectra. Both collected at room temperature.

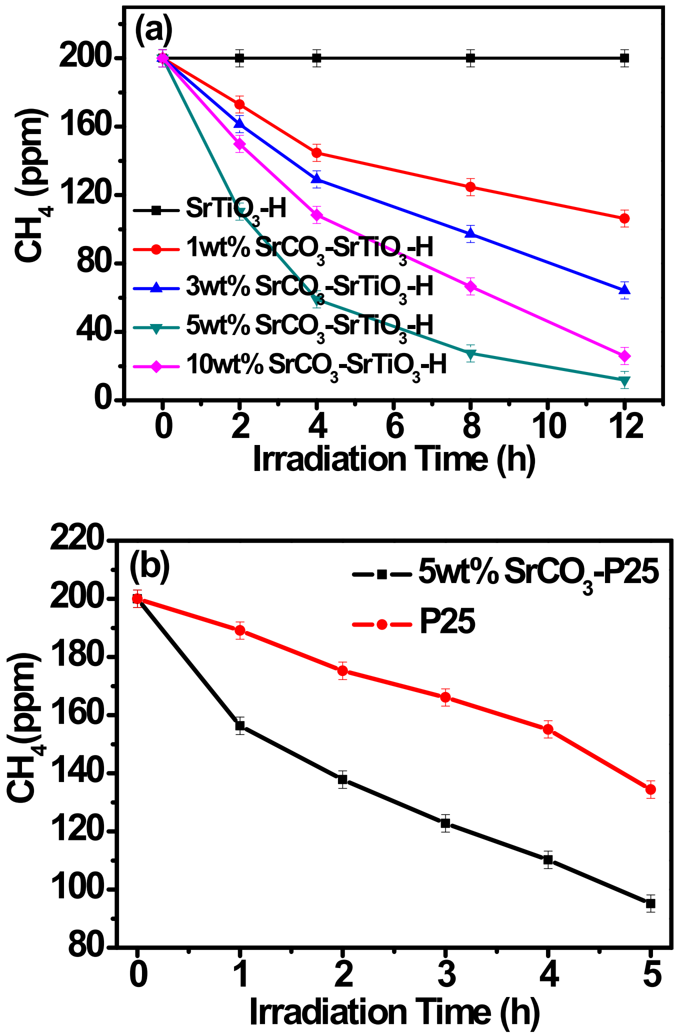


Fig. S8. Photocatalytic oxidation of methane over $SrCO_3$-$SrTiO_3$-H nanocomposites under simulated solar light irradiation (a); Photocatalytic CH_4 oxidation performance of the P25 sample and the 5.0wt% $SrCO_3$ loaded P25 (5wt%$SrCO_3$-P25) sample under simulated solar light illumination (b).

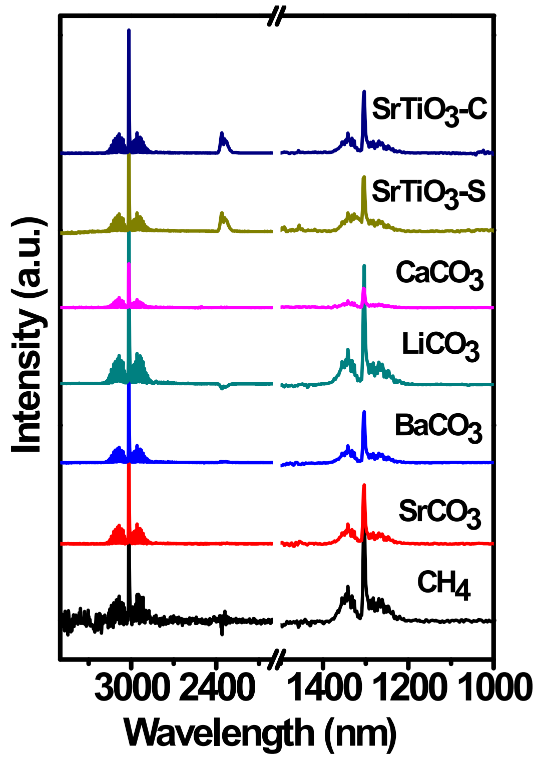


Fig. S9. Infrared spectra of CH_4 adsorption upon various materials at room temperature.

Table S2. IR bands of CH_4 adsorbed on different samples.

	ν_1(C-H)	ν_2 (C-H)
CH_4	3015.84	1303.94
$SrCO_3$	3016.07	1304.33
$BaCO_3$	3016.02	1304.22
$LiCO_3$	3016.30	1302.73
$CaCO_3$	3016.14	1304.12

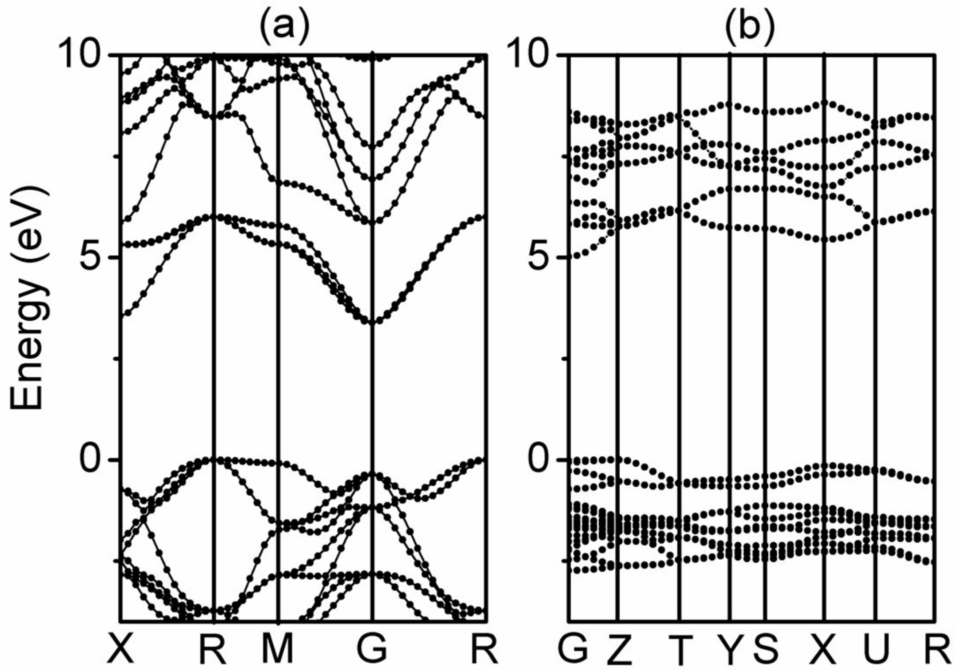


Fig. S10. Energy Band diagram of: a, $SrTiO_3$. b, $SrCO_3$.

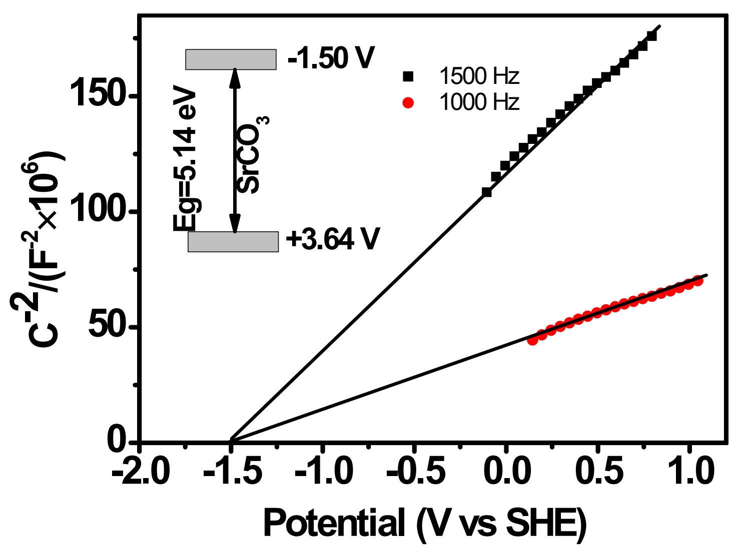


Fig. S11. Mott-Schottky plot of $SrCO_3$ at different frequency; the inset shows the energy band structure of $SrCO_3$.

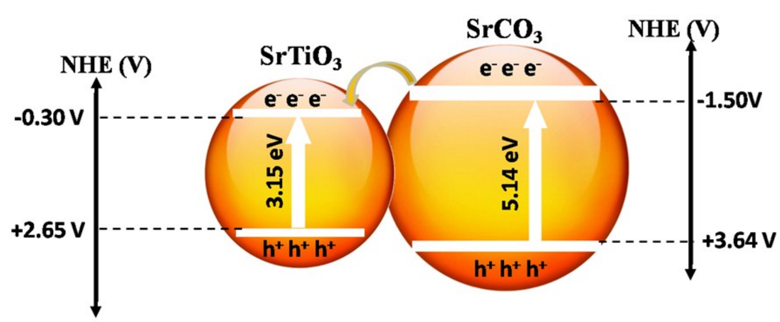


Fig. S12. Proposed charge separation process over $SrCO_3/SrTiO_3$ nanocomposite. Herein the defects excitation within $SrCO_3$ is omitted for simplicity.