Surface Photovoltage Spectroscopy Observes Photochemical Charge Transfer in Nanoscale Hydrogen Evolving Photocatalyst

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Electronic Supplementary Information (3 pages)

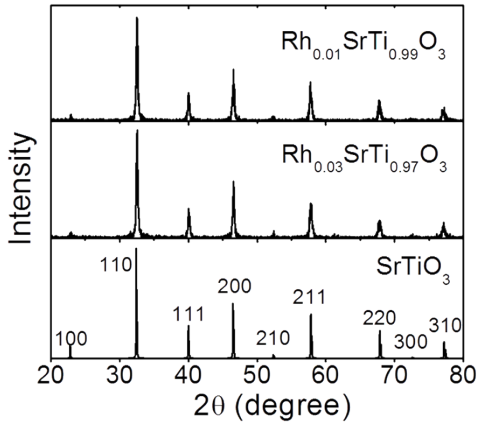

Figure S1. Powder X-Ray diffraction of $SrRh_{0.03}Ti_{0.97}O_3$ (the pattern of $SrTiO_3$ are from ICDD PDF Card 00-002-1454). The sizes of the particles were calculated by Scherrer Equation to be 35.1±1.3 nm. This is close to the TEM diameter (20-75 nm), suggesting the presence of single crystals.

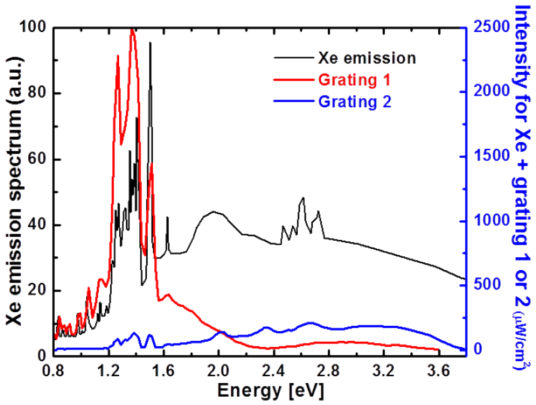

Figure S2. Spectra of SPS light source (Grating 2 was used for all the measurements)

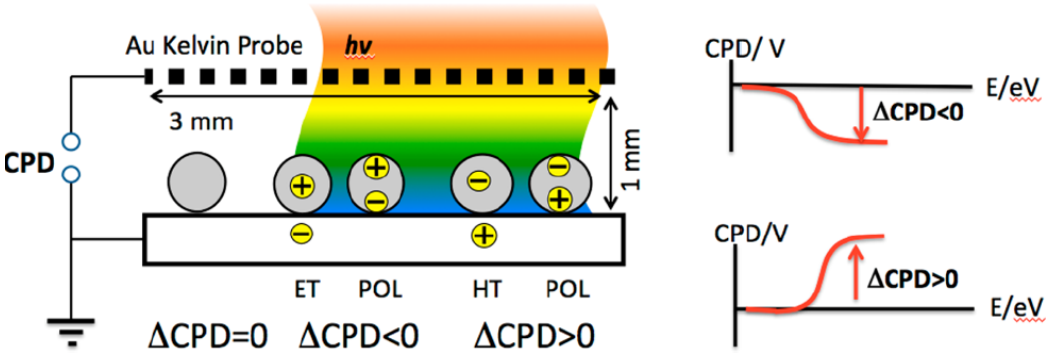

Figure S3. SPS configuration and example spectra showing the generation of a photovoltage as a result of photochemical charge transfer in the sample film. [1] Reprinted with permission from Ref. 1. Copyright 2014, American Chemical Society.

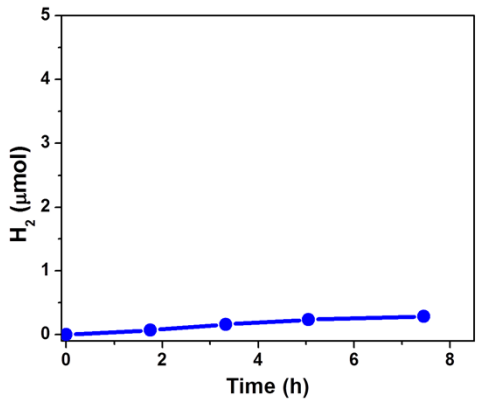

Figure S4. Visible light driven hydrogen evolution from Rh(3mol%):$SrTiO_3$-Pt(2%) in water under 380 mW/cm² illumination from a 300 W Xe lamp with filter (>400 nm).

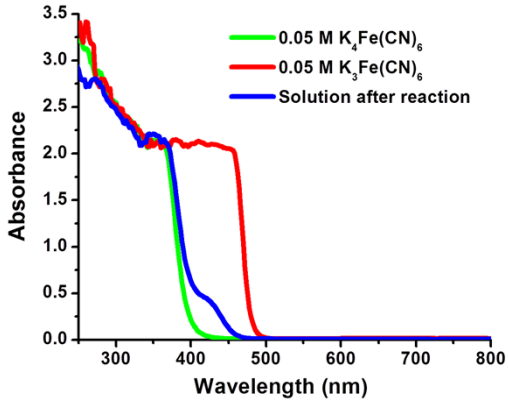

Figure S5. UV/Vis absorbance spectra of 0.05 M potassium ferrocyanide (green), 0.05 M potassium ferricyanide (red) and the solution after visible light hydrogen evolution reaction with 50 mL 0.05 M potassium ferrocyanide as the sacrificial agent (reaction shown in Figure 3D). A quartz cell of 1 cm path length was used and pure water was used as reference. The photocatalyst is particularly sensitive to the light intensity change in the 400-500 nm. Also, from $T=10^{-A}$, a 0.2 absorbance (at 450 nm, solution after reaction, blue line) means that 37% of the light is lost by passing through merely 1 cm of the solution.

Table S1. Calculation of the electron and hole diffusion lengths for $SrTiO_3$

Parameter	electron	hole	Reference
Diffusion Length L [m] = SQRT(D t) for Fe-doped $SrTiO_3$		**1.51E-07**	
Diffusion Length L [m] = SQRT(D t) for $SrTiO_3$ single crystals	**4.09E-06**	**3.26E-06**	
Lifetime [s] at 298 K for $SrTiO_3$ single crystal	5.88E-08	5.88E-08	
Recombination coefficient A [s^{-1}] at 298 K for $SrTiO_3$ single crystal	1.70E+07	1.70E+07	[2]
Diffusion Coefficient D[m^2 s^{-1}] = m kT/e for Fe-doped $SrTiO_3$		3.88E-07	Einstein Relation
Diffusion Coefficient D[m^2 s^{-1}] = m kT/e for $SrTiO_3$ single crystals	2.85E-04	1.81E-04	Einstein Relation
Mobility [m^2 s^{-1} V^{-1}] at 800 K for Fe-doped $SrTiO_3$		1.50E-05	[3]
Mobility [m^2 s^{-1} V^{-1}] at 4 K for $SrTiO_3$ single crystals	1.10E-02	7.00E-03	[4]
Boltzmann Constant k [J K^{-1}]	*1.38E-23*	*1.38E-23*	
Temperature T [K]	*300*	*300*	
electron charge e [As]	*1.60E-19*	*1.60E-19*	

References

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