Supporting Information for:

Photogenerated Charge Carriers Dynamics on La and/or Cr Doped $SrTiO_3$ Nanoparticles Studied by Transient Absorption Spectroscopy

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Table S1. Atomic ratio and optical bandgaps of the synthesized undoped and La, Cr-codoped $SrTiO_3$ samples

	Sr contents(from XPS) [atom%]	Ti contents(from XPS) [atom%]	La contents(from XPS) [atom%]	Cr contents(from XPS) [atom%]	Band gap [eV]
$SrTiO_3$	52.9%	47.1%	--	--	3.20
La-doped $SrTiO_3$	34.5%	53.1%	12.4%	--	3.25
La, Cr-codoped $SrTiO_3$	46.6%	46.6%	2.2%	4.6%	2.08
Cr-doped $SrTiO_3$	49.4%	36.3%	--	14.3%	1.39

Atomic ratio of the samples were calculated from the XPS spectra of each cation elements and listed on Table S1.

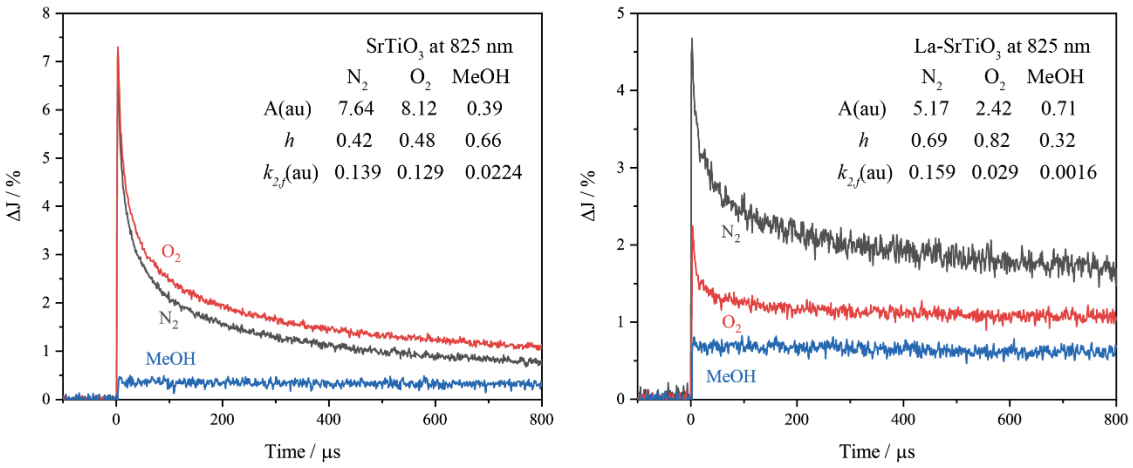

Figure S1. Transient decay curves of the undoped $SrTiO_3$ (a) and La-doped $SrTiO_3$ (b) at 825 nm

The decay kinetics of transient absorption in the undoped $SrTiO_3$ and La-doped $SrTiO_3$ were monitored in the presence and absence of O_2 gas and MeOH vapor. As shown in Figure S1, changes in the intensity at 825 nm were measured. For the decay kinetics in the undoped $SrTiO_3$, the decay process was decelerated at 0−800 μs and accelerated by exposure to O_2 gas and MeOH vapor, respectively. Since these molecules act as electrons and holes scavenger, as same as the absorption at 765 nm, the spectra indicate that the absorption intensity at 825 nm reflects the population of holes. On the other hand, the decay kinetics in La-doped $SrTiO_3$ exhibited a different trend: the absorption intensity decreased with exposure to MeOH vapor, suggesting that the intensity at 825 nm reflects the population of holes. However, the presence of O_2 also decreased the absorption intensity lower than

that in the N_2 gas. This result suggests that the absorption at 825 nm also reflects the population of electrons. As a result, the intensity at 825 nm includes signal from both electrons and holes.

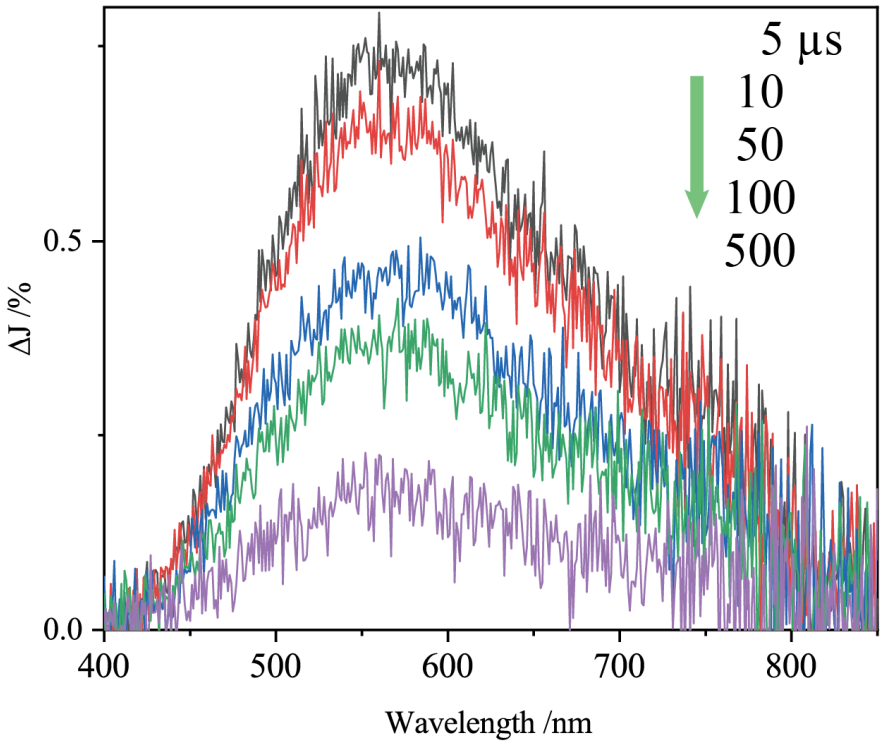

Figure S2. Transient absorption spectra of 10% La, Cr-codoped $SrTiO_3$

Transient absorption spectra of 10% La, Cr-codoped $SrTiO_3$ induced by 355 nm laser pulse irradiation are shown in Figure S2. After photoexcitation, the spectra feature of the undoped $SrTiO_3$ has been disappeared and a new broad absorption arised over the entire region from 400 to 800 nm with the peak top at 560 nm.

Appendix: Fitting parameters and standard errors of the fractal kinetics fits ($\Delta J = A(1-h)/[(1-h) + Ak_{2,f}t^{1-h}]$) of the transient absorption signals of the photogenerated charge carriers in samples after excitation with 1 mJ/cm^2 ($\lambda_{ex} = 355$ nm).

Table S2. The fitting results of the transient absorption decay in the Figure 5.

	A	**Standard error**	***h***	**Standard error**	$k_{2,f}$	**Standard error**
$SrTiO_3$ 765 nm N_2	7.70	0.04156	0.44	0.00184	0.013	1.05564E-4
$SrTiO_3$ 765 nm O_2	8.08	0.05038	0.49	0.00191	0.012	1.04548E-4
$SrTiO_3$ 765 nm MeOH	0.68	0.06618	0.85	0.02938	0.06	0.00774
La-$SrTiO_3$ 765 nm N_2	5.41	0.12677	0.68	0.00735	0.012	4.06303E-4
La-$SrTiO_3$ 765 nm O_2	2.58	0.06122	0.81	0.00607	0.018	4.96501E-4
La-$SrTiO_3$ 765 nm MeOH	1.07	0.01168	0.82	0.18834	0.014	6.09585E-4

Table S3. The fitting results of the transient absorption decay in the Figure 6.

	A	**Standard error**	***h***	**Standard error**	$k_{2,f}$	**Standard error**
$SrTiO_3$ 0-50 μs	1	0.01456	0.36	0.02004	0.087	0.00397
$SrTiO_3$ 50-100 μs	0.96	1.21676	0.47	0.37023	0.103	0.1649
$SrTiO_3$ 100-400 μs	0.98	0.28934	0.45	0.04783	0.100	0.02616
La-$SrTiO_3$ 0-50 μs	1	0.02697	0.53	0.04733	0.049	0.00526
La-$SrTiO_3$ 50-100 μs	0.80	0.55528	0.33	1.2506	0.018	0.09494
La-$SrTiO_3$ 100-400 μs	0.71	0.13913	0.49	0.21561	0.02	0.02484

Table S4. The fitting results of the transient absorption decay in the Figure 7.

	A	**Standard error**	***h***	**Standard error**	$k_{2,f}$	**Standard error**
Cr-$SrTiO_3$ 600 nm N_2	0.62	0.0253	0.46	0.01383	0.115	0.00771
Cr-$SrTiO_3$ 600 nm O_2	0.60	0.02547	0.46	0.01352	0.119	0.00784
Cr-$SrTiO_3$ 600 nm MeOH	0.61	0.01788	0.36	0.01613	0.068	0.00529
La, Cr-$SrTiO_3$ 560 nm N_2	1.61	0.0143	0.29	0.00779	0.026	6.51407E-4
La, Cr-$SrTiO_3$ 560 nm O_2	1.65	0.01365	0.29	0.00759	0.028	6.56136E-4
La, Cr-$SrTiO_3$ 560 nm MeOH	2.41	0.02246	0.46	0.00388	0.036	6.0999E-4
La, Cr-$SrTiO_3$ 765 nm N_2	1.85	0.05156	0.54	0.00701	0.118	0.00304
La, Cr-$SrTiO_3$ 765 nm O_2	2.53	0.05952	0.51	0.00601	0.100	0.00217
La, Cr-$SrTiO_3$ 765 nm MeOH	3.23	0.06084	0.50	0.00484	0.0665	0.00122

Table S5. The fitting results of the transient absorption decay in the Figure 8.

	A	Standard error	h	Standard error	$k_{2,f}$	Standard error
La, Cr-$SrTiO_3$ 560 nm N_2	1	0	0.33	0.0053	0.048	0.00103
La, Cr-$SrTiO_3$ 600 nm N_2	1	0	0.37	0.00395	0.044	7.09095E-4
La, Cr-$SrTiO_3$ 560 nm MeOH	0.98	0.00933	0.46	0.00388	0.084	0.00147
La, Cr-$SrTiO_3$ 600 nm MeOH	0.97	0.01037	0.48	0.00416	0.089	0.00168

Table S6. The fitting results of the transient absorption decay in the Figure S1.

	A	Standard error	h	Standard error	$k_{2,f}$	Standard error
$SrTiO_3$ 825 nm N_2	7.64	0.04027	0.42	0.00202	0.014	1.20491E-4
$SrTiO_3$ 825 nm O_2	8.12	0.05425	0.48	0.0024	0.013	1.3574E-4
$SrTiO_3$ 825 nm MeOH	0.39	0.03042	0.66	0.17123	0.0224	0.02034
La-$SrTiO_3$ 825 nm N_2	5.17	0.11027	0.69	0.0067	0.016	4.793E-4
La-$SrTiO_3$ 825 nm O_2	2.42	0.05548	0.82	0.00542	0.029	6.3012E-4
La-$SrTiO_3$ 825 nm MeOH	0.71	0.01131	0.32	0.14453	0.0016	0.00134