Crucial impact of reduction on the photocarriers dynamics on $SrTiO_3$ powders studied by transient absorption spectroscopy

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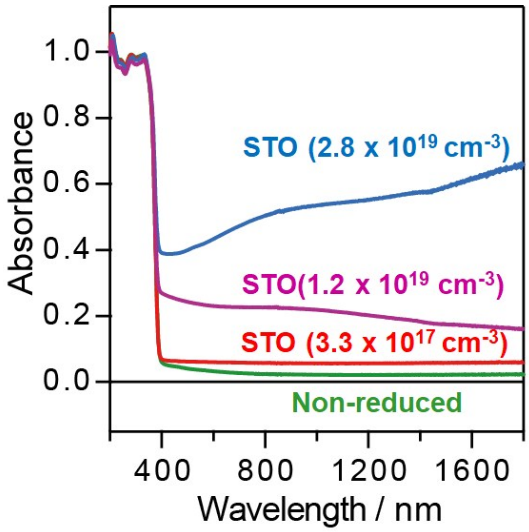

Figure S1. Diffuse-reflectance absorption spectra of non-reduced and reduced $SrTiO_3$. The values inside the parentheses indicate the electron density in reduced $SrTiO_3$ powders. The effect of reduction on the optical absorption characteristics of $SrTiO_3$ is more apparent at longer wavelengths, i.e. absorption at > 400 nm is higher for reduced $SrTiO_3$ compared to non-reduced $SrTiO_3$. The powder samples were prepared on CaF_2 circular plates and the absorption spectra were measured under diffuse-reflectance mode.

Table S1. Annealing oxygen partial pressure and estimated electron density of $SrTiO_3$ powders[1]

entry	Oxygen partial pressure / atm	Electron density / cm^{-3}
1	2×10^{-1}	-
2	$(5.0 \pm 0.1) \times 10^{-11}$	3.3×10^{17}
3	$(2.7 \pm 0.1) \times 10^{-17}$	1.2×10^{19}
4	$(9 \pm 3) \times 10^{-19}$	2.8×10^{19}

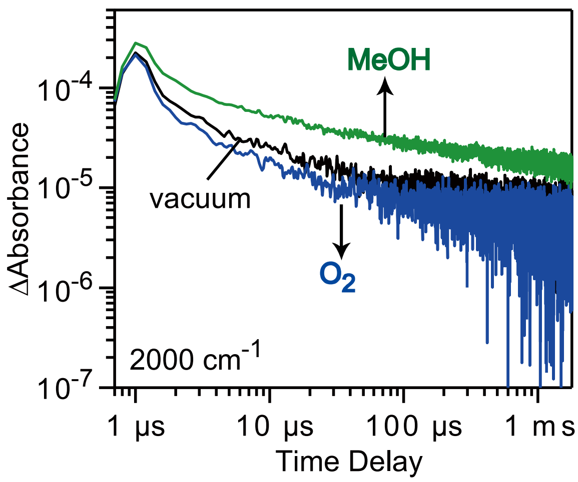

Figure S2. Decay kinetics of electrons at 2000 cm^{-1} (5000 nm) in vacuum and in the presence of oxygen and methanol. The slightly reduced $SrTiO_3$ powder (electron density: 3.3×10^{17} cm^{-3}) was excited by 355 nm laser pulses. The population of electrons decreased under oxygen and increase under methanol, indicative of electrons and holes are consumed by oxygen and methanol, respectively. [2-4]

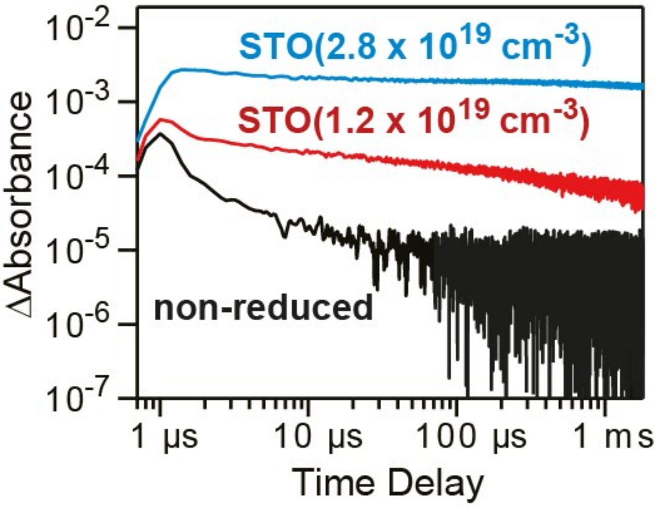

Figure S3. Transient profiles of electrons probed at 2000 cm^{-1} (5000 nm) upon band gap excitation (355 nm laser pulses, 0.5 mJ $pulse^{-1}$) of non-reduced and reduced $SrTiO_3$ with different electron density of 1.2 x 10^{19} and 2.8 x 10^{19} cm^{-3}. The decay curves were measured in vacuum. It is clear that the lifetime of free electrons drastically elongated by reduction (inducing oxygen vacancies on $SrTiO_3$ accompanied by Ti^{3+}).

References

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