

Supplementary Material

Magnetism Control by Doping in $\text{LaAlO}_3/\text{SrTiO}_3$ Heterointerfaces

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The films of LAO and LARO ($R=\text{Fe, Co, Ni and Cu}$) were deposited on the TiO_2 -terminated SrTiO_3 (STO) substrates using the pulsed laser deposition method. The surface morphology of heterointerfaces shows a flat terrace-like surface, as shown in Figure S1-S3. The Hall measurements for all interfaces have been performed at several temperatures as shown in Figure S4. The temperature dependences of the magnetization of LACoO and LANiO heterointerfaces are measured with increasing temperature and an applied field of 4 T as shown in Figure S5. There is no magnetic signal observed for LAO and LACuO thin films (Figure S6). The resistances of heterointerfaces under the irradiation decrease at different temperatures and cannot restore their originating values (Figure S7-S11). The fitting results of the time constant τ_1 for the decay process are shown in Figure S12.

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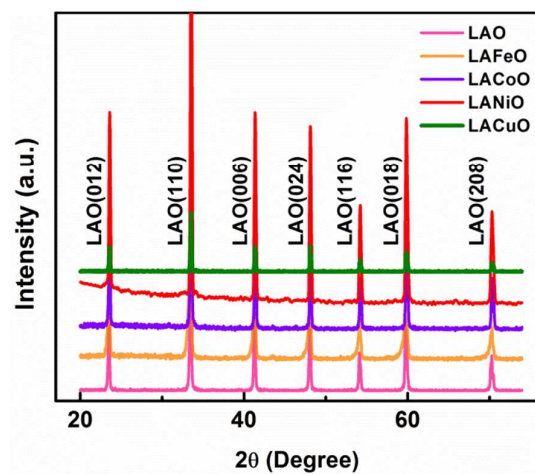


Figure S1. X-ray diffraction pattern of the LAO and LARO ($R=\text{Fe, Co, Ni and Cu}$) targets.

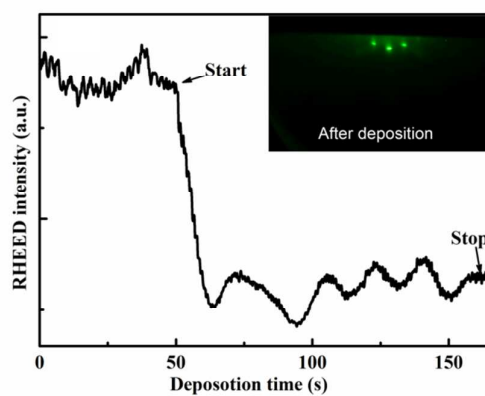


Figure S2. RHEED intensity oscillations recorded along the (001) crystallographic direction during the fabrication of 5 u.c. LAO/STO.

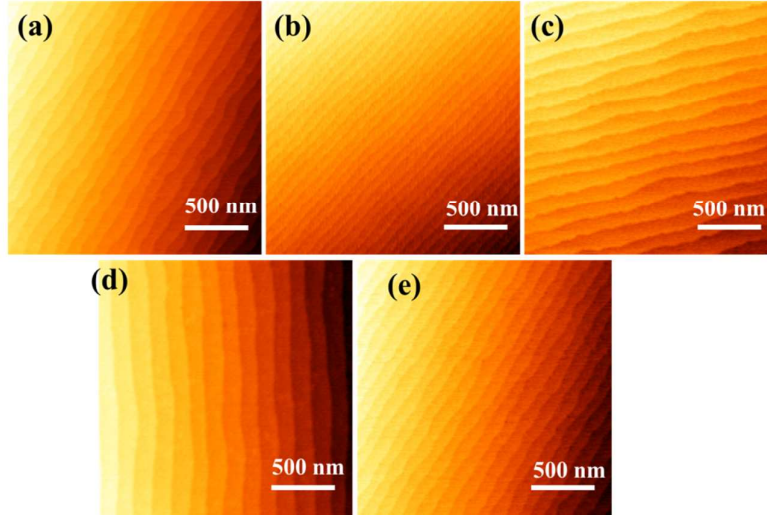


Figure S3. (a), (b), (c), (d) and (e) AFM images of LAO and LARO ($R = \text{Fe, Co, Ni, Cu}$) films on STO substrates. The images show a flat terrace-like surface. The scale bar is 500 nm.

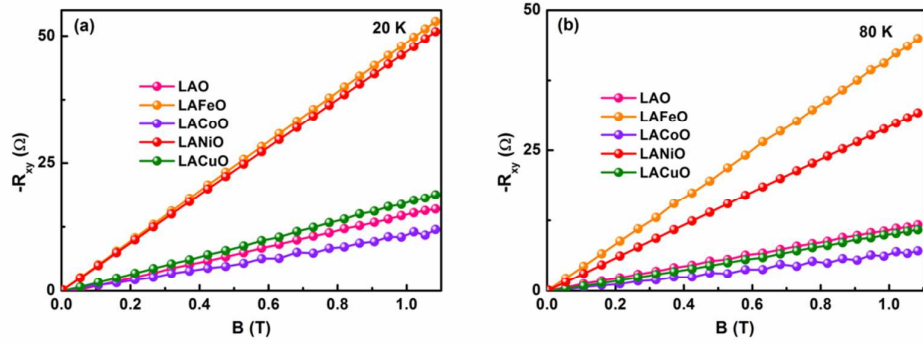


Figure S4. Hall resistance of LAO and LARO ($R = \text{Fe, Co, Ni and Cu}$) samples as a function of magnetic field at 20 K (a) and 80 K (b) in darkness.

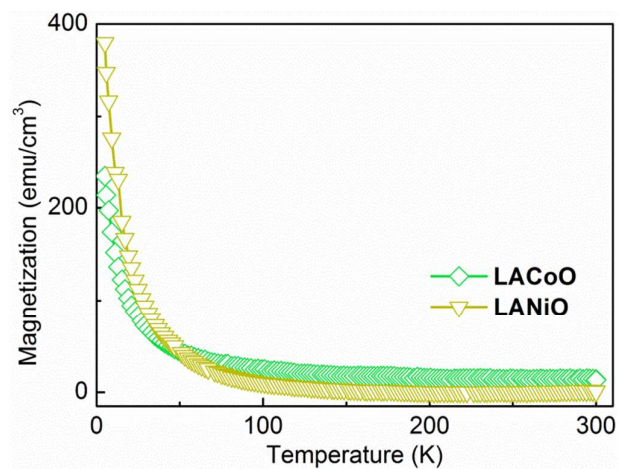


Figure S5. Magnetization measurements at $H = 4$ T as a function of temperature for LACoO and LANiO thin films.

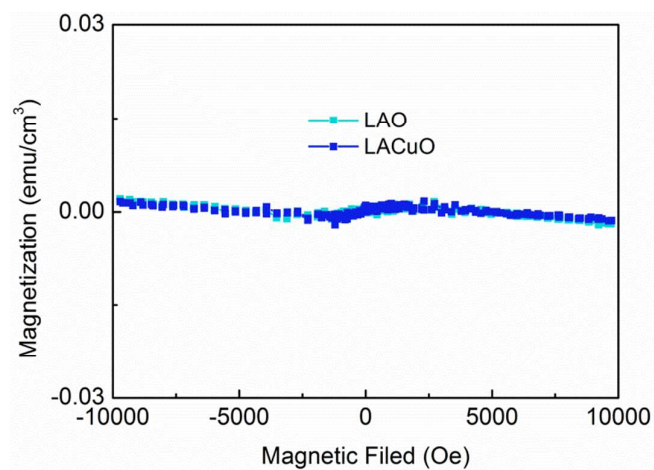


Figure S6. Magnetization measurements measured at 10 K as a function of magnetic field for LAO and LACuO thin films. There is no magnetic signal observed.

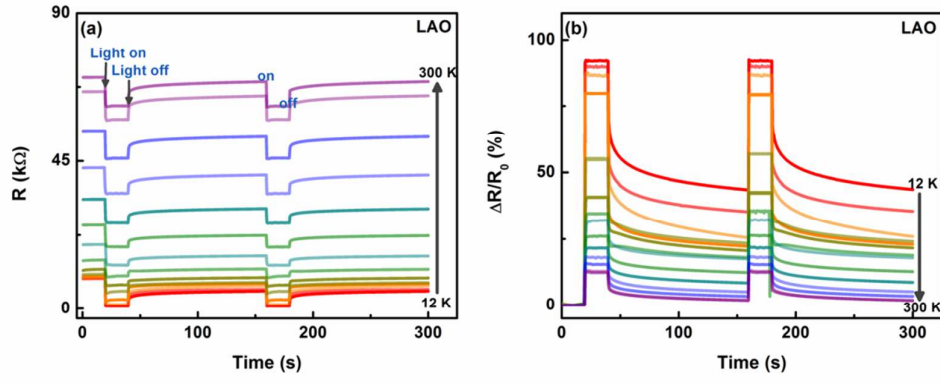


Figure S7. Time evolution of the resistance (a) and the normalized resistance $\Delta R/R_0$ (b) at LAO/STO heterointerfaces under the irradiation of light at different temperatures.

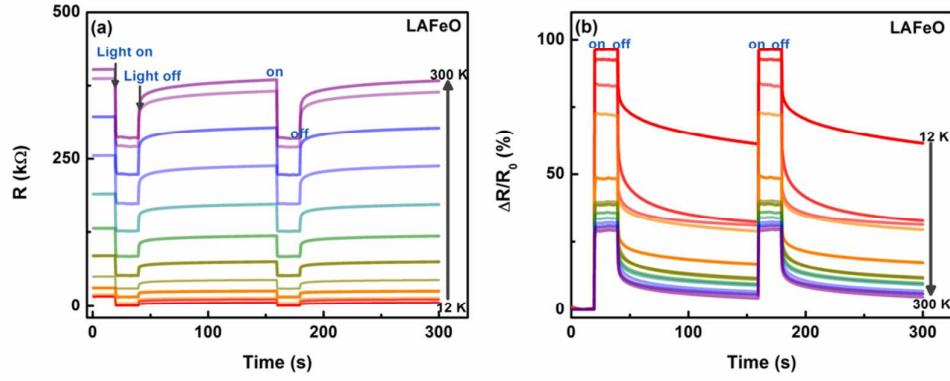


Figure S8. Time evolution of the resistance (a) and the normalized resistance $\Delta R/R_0$ (b) at LAFEO/STO heterointerfaces under the irradiation of light at different temperatures.

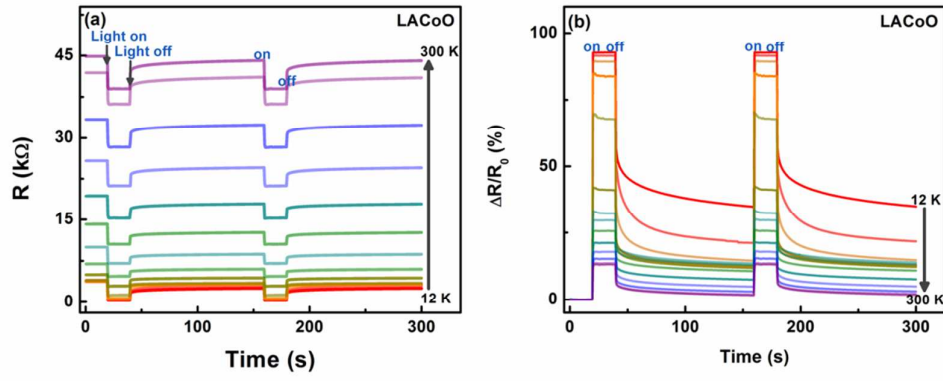


Figure S9. Time evolution of the resistance (a) and the normalized resistance $\Delta R/R_0$ (b) at LACoO/STO heterointerfaces under the irradiation of light at different temperatures.

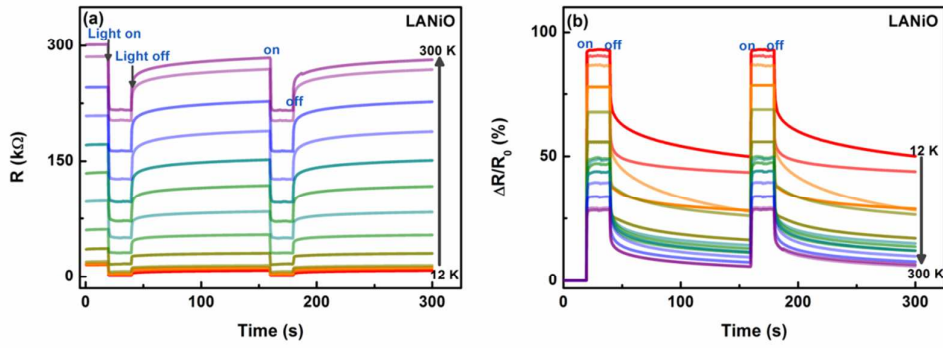


Figure S10. Time evolution of the resistance (a) and the normalized resistance $\Delta R/R_0$ (b) at LANiO/STO heterointerfaces under the irradiation of light at different temperatures.

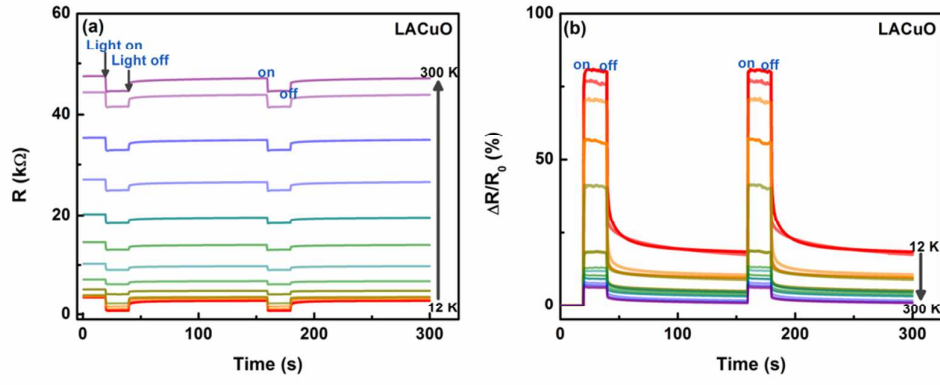


Figure S11. Time evolution of the resistance (a) and the normalized resistance $\Delta R/R_0$ (b) at LACuO/STO heterointerfaces under the irradiation of light at different temperatures.

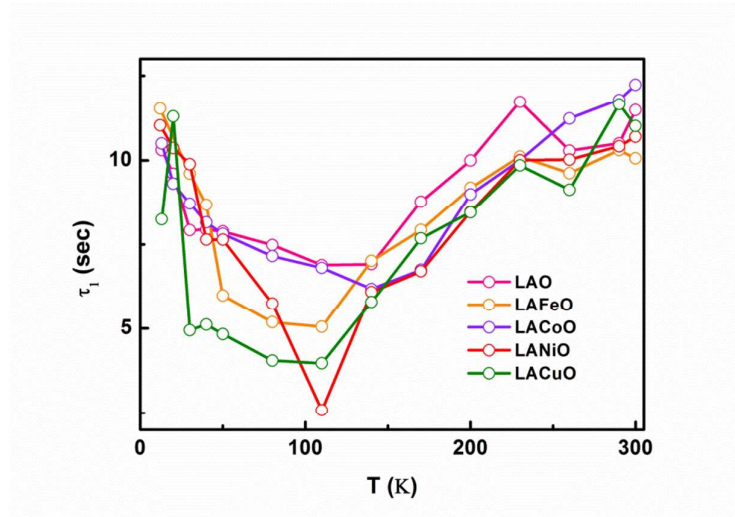


Figure S12. The time constant τ_1 as a function of temperature.