Supporting Informations



Figure S1 TA response of $CH_3NH_3PbClI_2/Y_2O_3$ without *spiro*-OMeTAD for a time scale of 100 µs measured with a pump light wavelength of 470 nm and a probe light wavelength of 658 nm. The red solid lines represent the fitting results with eq. (1).



Figure S2 Normalized TA response of $CH_3NH_3PbClI_2/TiO_2$ (cell B) measured with a lower pump light intensity (0.5 μ J/cm²) and theoretical fitting result of the TA response to a one exponential function with a time constant of 0.69±0.02 ns. The pump light wavelength was 470 nm and the probe light wavelength was 775 nm.



Figure S3 TA response of CH₃NH₃PbClI₂/TiO₂ (cell B) measured with a pump light wavelength of 470 nm and a probe light wavelength of 658 nm. The red solid line represents the fitting result with a one exponential decay function with a time constant of 0.13 ± 0.01 µs.



Figure S4. TA response of $CH_3NH_3PbClI_2/TiO_2$ (cell B) with *spiro*-OMeTAD as the HTM measured with a pump light wavelength of 470 nm and a probe light wavelength of 1310 nm. The red solid line represents the fitting result with a one exponential decay function with a time constant of 600±6 µs.