Supporting Informations

Figure S1  TA response of CH$_3$NH$_3$PbClI$_2$/Y$_2$O$_3$ 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$_3$NH$_3$PbClI$_2$/TiO$_2$ (cell B) measured with a lower pump light intensity (0.5 μJ/cm$^2$) 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 CH$_3$NH$_3$PbClI$_2$/TiO$_2$ (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$_3$NH$_3$PbClI$_2$/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.