Supporting Information

Ultrafast photoinduced carrier dynamics in single crystalline perovskite film

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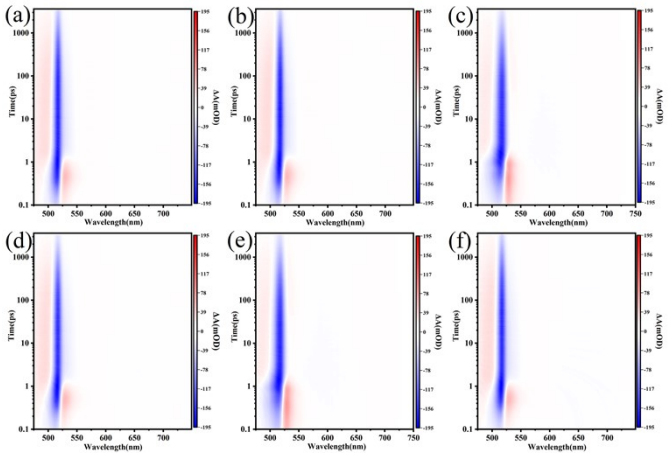

Fig. S1 (a-f) Pseudo colour diagram of TA spectra obtained at different test sites of the internal region of $CsPbBr_3$ single crystal.

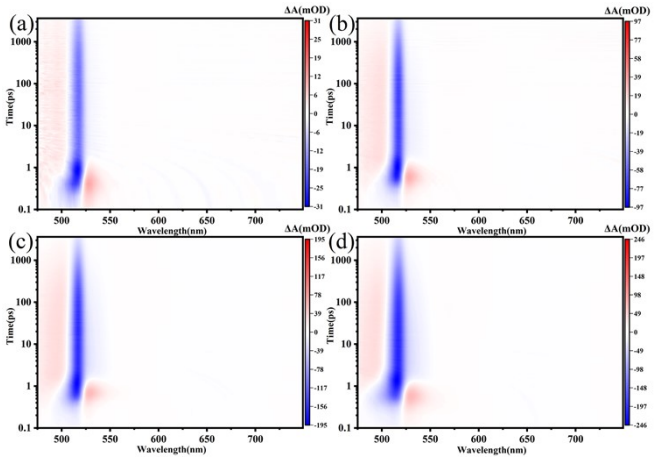

Fig. S2 Pseudo colour image of TA spectra acquired at the internal region of $CsPbBr_3$ single crystal film under different light injection carrier concentrations n_0. (a) $n_0 = 5.66\times10^{17}cm^{-3}$; (b) $n_0 = 9.4\times10^{17}cm^{-3}$; (c) $n_0 = 1.89\times10^{18}cm^{-3}$; (d) $n_0 = 2.83\times10^{18}cm^{-3}$.

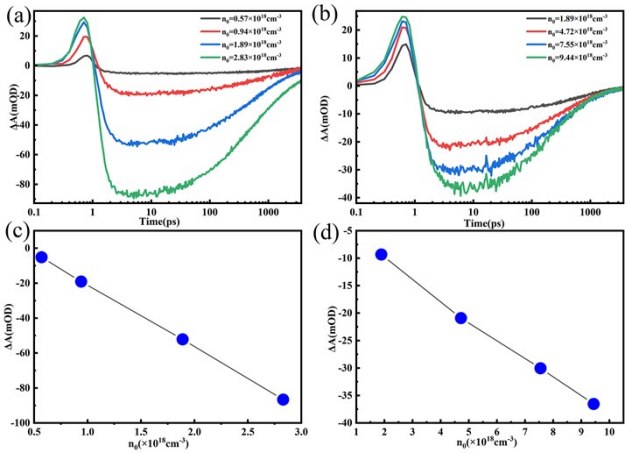

Fig. S3 Dynamic process of ground state bleaching signal under different light injection carrier concentrations at the (a) internal region and at the (b) boundary region. The relationship between the maximum ground state bleaching signal intensity and the concentration of light injected carriers

at the (c) internal region and at the (d) boundary region.

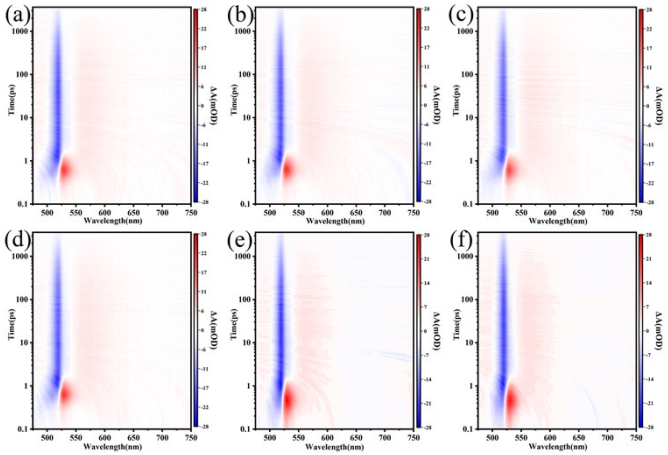

Fig. S4 (a-f) Pseudo colour diagram of TA spectra obtained at different test sites of the boundary region of $CsPbBr_3$ single crystal.

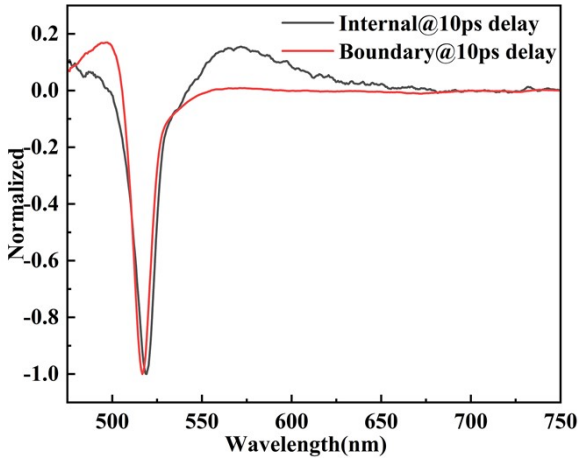

Fig. S5 Normalized TA spectra of internal and boundary region at 10 ps delay time.

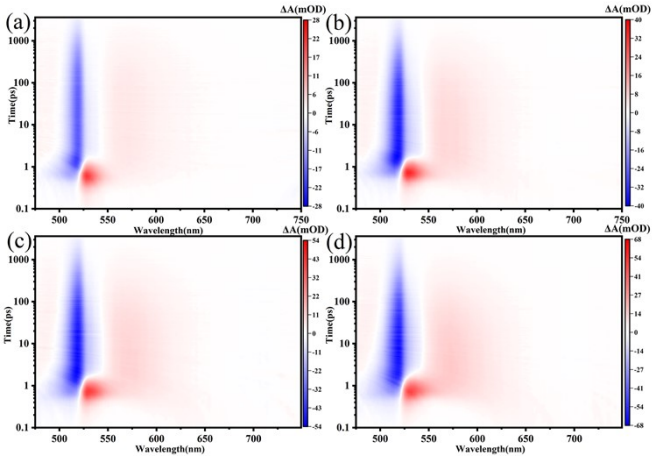

Fig. S6 Pseudo colour image of TA spectra acquired at the boundary region of $CsPbBr_3$ single crystal film under different light injection carrier concentrations n_0. (a) $n_0 = 2.83\times10^{18}cm^{-3}$; (b) $n_0 = 4.72\times10^{18}cm^{-3}$; (c) $n_0 = 7.55\times10^{18}cm^{-3}$; (d) $n_0 = 9.44\times10^{18}cm^{-3}$.

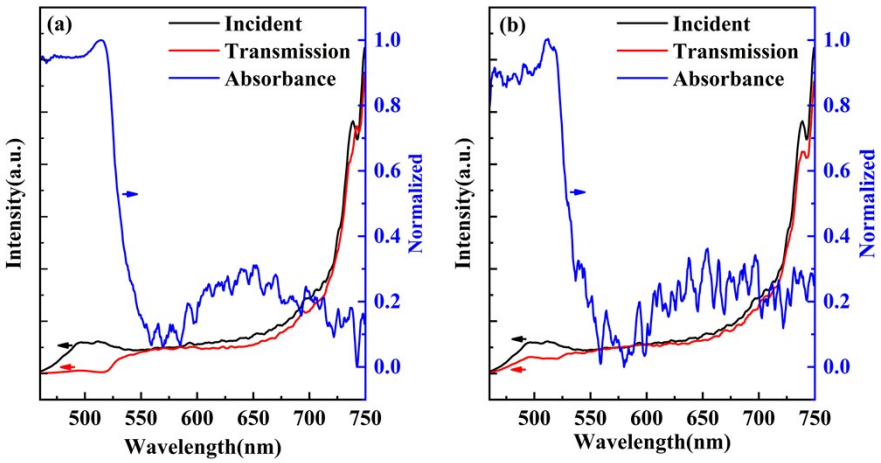

Fig. S7 Linear absorption spectra of $CsPbBr_3$ single crystal film acquired at (a) internal region and (b) boundary region.

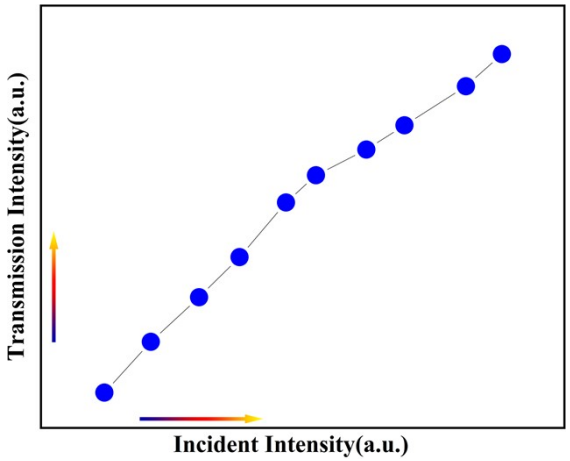

Fig. S8 The transmitted light intensity through the sample as a function of the incident light intensity.

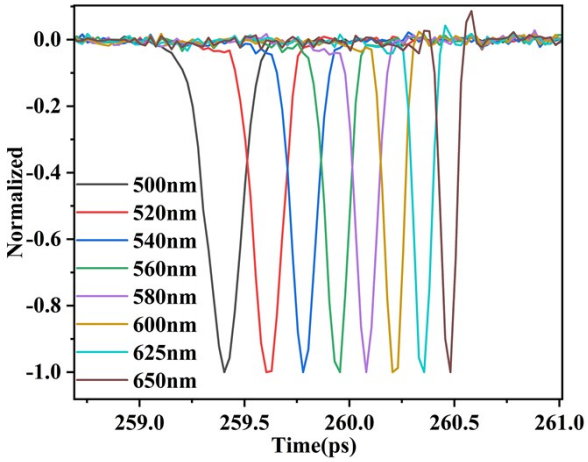

Fig. S9 Time characteristics of each wavelength of super continuum white light characterized by optical Kerr gate technique