

Supporting Information

Investigating dynamics of excitons in monolayer WSe₂ before and after organic super acid treatment

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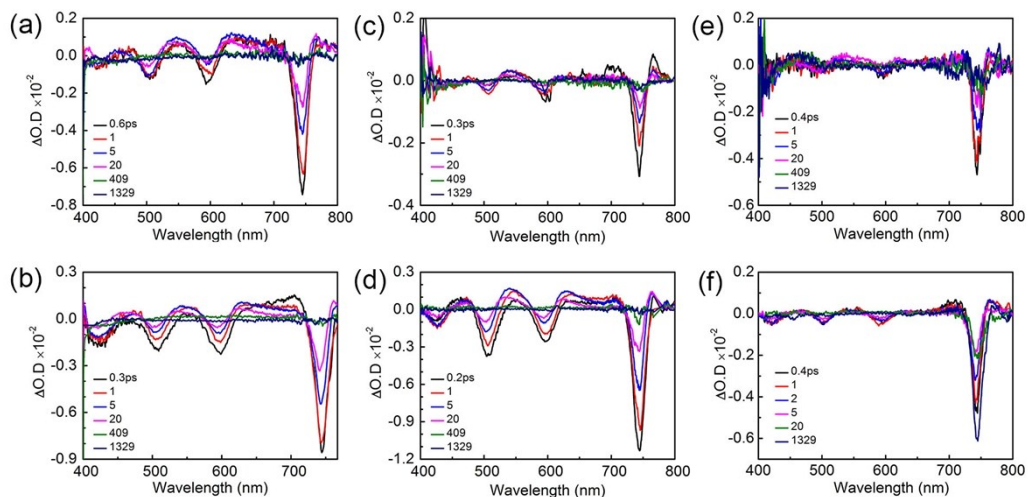


Figure S1. Measurements of organic super acid treated monolayer WSe₂ (osa-monolayer) by femtosecond pump-probe system. (a) Transient absorption (TA) spectrum of osa-monolayer WSe₂ excited under 400 nm pump pulse with pump fluence of 7.4 $\mu\text{J cm}^{-2}$. (b) TA spectrum of osa-monolayer WSe₂ excited under 400 nm pump pulse with pump fluence of 76 $\mu\text{J cm}^{-2}$. (c) TA spectrum of osa-monolayer WSe₂ excited under 610 nm pump pulse with pump fluence of 0.1 $\mu\text{J cm}^{-2}$. (d) TA spectrum of osa-monolayer WSe₂ excited under 610 nm pump pulse with pump fluence of 0.52 $\mu\text{J cm}^{-2}$. (e) TA spectrum of osa-monolayer WSe₂ excited under 730 nm pump pulse with pump fluence of 0.12 $\mu\text{J cm}^{-2}$. (f) TA spectrum of osa-monolayer WSe₂ excited under 730 nm pump pulse with pump fluence of 0.14 $\mu\text{J cm}^{-2}$.

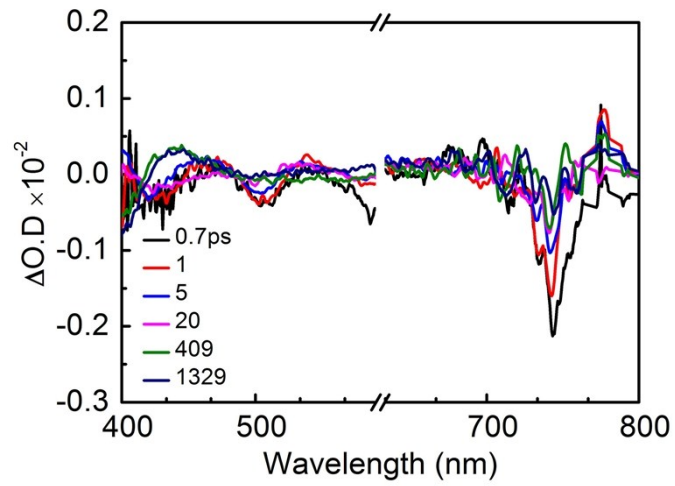


Figure S2. Measurements of monolayer WSe₂ without organic super acid treated by femtosecond pump-probe system. TA spectrum of monolayer WSe₂ excited under 610 nm pump pulse with pump fluence of 4.4 $\mu\text{J cm}^{-2}$.

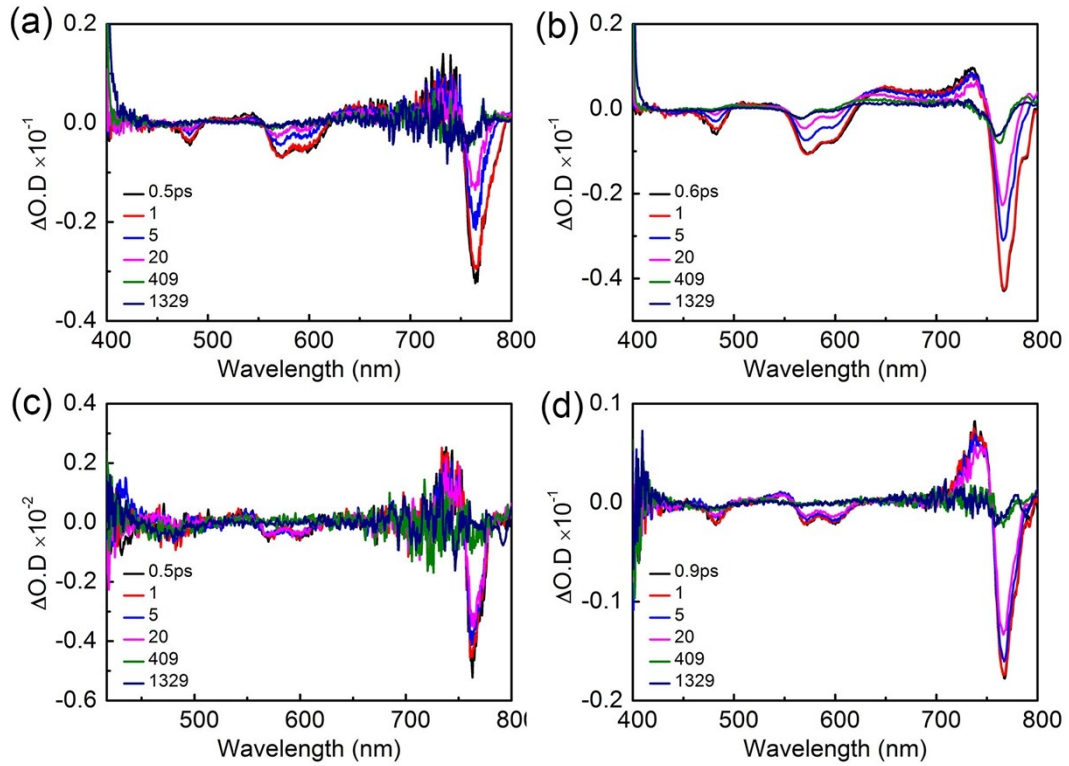


Figure S3. Measurements of bulk WSe_2 by femtosecond pump-probe system. (a) TA spectrum of bulk WSe_2 excited under 400 nm pump pulse with pump fluence of $71 \mu\text{J cm}^{-2}$. (b) TA spectrum of bulk WSe_2 excited under 400 nm pump pulse with pump fluence of $141 \mu\text{J cm}^{-2}$. (c) TA spectrum of bulk WSe_2 excited under 800 nm pump pulse with pump fluence of $22 \mu\text{J cm}^{-2}$. (d) TA spectrum of bulk WSe_2 excited under 800 nm pump pulse with pump fluence of $55 \mu\text{J cm}^{-2}$.

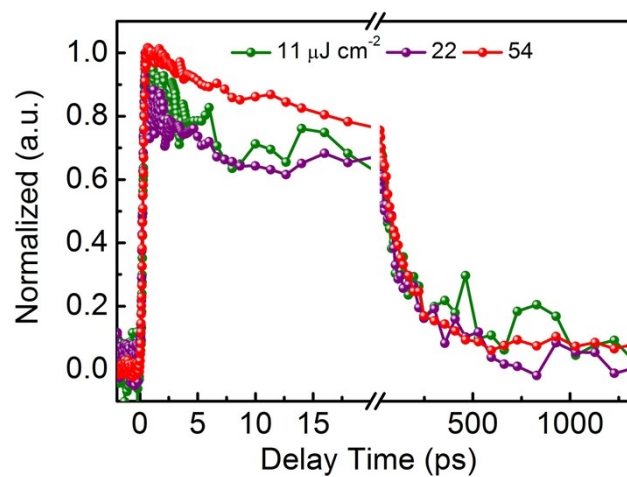


Figure S4. The normalized dynamics of A-exciton for bulk WSe₂ under 800 nm excitation with three pump fluences. Green line: pump fluence of 11 $\mu\text{J cm}^{-2}$, purple line: pump fluence of 22 $\mu\text{J cm}^{-2}$, red line: pump fluence of 54 $\mu\text{J cm}^{-2}$.

Table S1. The enlargement factor of GSB signal of A exciton for monolayer WSe₂ after organic super acid treatment under different pump fluences.

610 nm excitation	osa-monolayer WSe ₂					Untreated monolayer WSe ₂
Pump fluence ($\mu\text{J cm}^{-2}$)	0.1	0.33	0.52	1.1	2	4.4
$\Delta\text{O.D. intensity}$ ($\times 10^{-2}$)	0.23	0.84	1.04	0.51	0.68	0.21
Enlargement factor	48	53	42	9.7	7.1	---