nanomaterials

Supplementary Materials

Filling Exciton Trap-States in Two-Dimensional Tungsten Disulfide (WS_2) and Diselenide (WSe_2) Monolayers

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Spectral analysis of transient spectra:

To spectrally resolve the different components of the positive induced absorption (IA) band observed in Figure 2 in the Main Text, we conducted a multi-Gaussian peak fit of transient absorption spectra taken at 10 ps time-delays. This time-delay is chosen because by 10 ps, the IAs resulting from exciton line broadening due to many-body interactions have recovered [1–4]. The returned fitting parameters are listed in Table S1 for 2D-WS_2 and Table S2 for 2D-WSe_2.

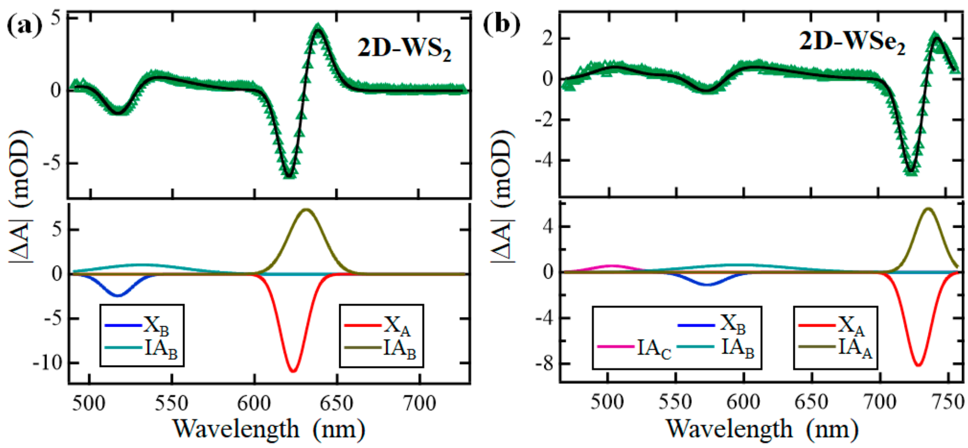

Figure S1. Multi-peak fitting of a transient absorption spectrum collected 10 ps following exciton of the monolayer of 2D-WS_2 **(a)**, and 2D-WSe_2 **(b)**. The individual components of the fits are shown in the bottom panels.

In the case of 2D-WS_2, we identified four compenents; two negative peaks corresponding to depletions of excitons X_A and X_B, and two positive features IA_A near X_A and IA_B near X_B. In the case of 2D-WSe_2, and additional IA_C was indentified. We note that the probe used in both sample starts at 480 nm, which allows us to capture the IA_C, in 2D-WS_2, one expects the existance of a similar IA at shorter wavelengths that we can not capture using our probe.

Table S1. List of the muti-Gaussian peak fit of a transient absorption spectrum measured at 10 ps following excitation of the 2D-WS_2 monolayer at 3.1 eV with 4 J·cm^{-2}. I (mOD): peak amplitude; C_0 (nm): peak center; w(nm): full width at half maximum of the peak.

	X_B	**IA_B**	**X_A**	**IA_A**
I (mOD)	−2.45	+1.05	−11.2	+7.4
C_0 (nm)	517.2	531.9	623.4	631.0
w (nm)	20.5	61.4	18.1	24.8

Table S2. List of the muti-Gaussian peak fit of a transient absorption spectrum measured at 10 ps following excitation of the 2D-WSe_2 monolayer at 3.1 eV with 2.8 J·cm^{-2}. I (mOD): peak amplitude; C_0 (nm): peak center; w(nm): full width at half maximum of the peak.

	IA_C	**X_B**	**IA_B**	**X_A**	**IA_A**
I (mOD)	+0.56	−1.10	+0.65	−8.15	+5.55
C_0 (nm)	503.4	573.1	596.5	728.1	735.2
w (nm)	35.1	29.7	89.3	21.1	22.9

Supplementary References

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4. Cunningham, P. D.; McCreary, K. M.; Jonker, B. T. Auger Recombination in Chemical Vapor Deposition-Grown Monolayer WS_2. *J. Phys. Chem. Lett.* **2016**, 7, 5242–5246.