Supplementary Materials

Observation of moiré excitons in the twisted WS_2/WS_2 homostructure

Biao Wu[1,2,], Haihong Zheng[1,2,], Shaofei Li[1], Junnan Ding[1], Yujia Zeng[3], Zongwen Liu[4,5] & Yanping Liu[1,2,6*]

1. *School of Physics and Electronics, Hunan Key Laboratory for Super-microstructure and Ultrafast Process, Central South University, 932 South Lushan Road, Changsha, Hunan 410083, People's Republic of China*
2. *State Key Laboratory of High-Performance Complex Manufacturing, Central South University, 932 South Lushan Road, Changsha, Hunan 410083, People's Republic of China*
3. *Department of Applied Physics, School of Physics and Electronics, Hunan University, Changsha 410082, People's Republic of China*
4. *School of Chemical and Biomolecular Engineering, The University of Sydney, NSW 2006, Australia*
5. *The University of Sydney Nano Institute, The University of Sydney, NSW 2006 Australia*
6. *Shenzhen Research Institute of Central South University, A510a, Virtual University Building, Southern District, High-tech Industrial Park, Yuehai Street, Nanshan District, Shenzhen. People's Republic of China*

* Correspondence and requests for materials should be addressed to email: liuyanping@csu.edu.cn

As shown in Figure S1, the PL spectra of the exfoliated bilayer and twisted homostructure (1.46°) at 8 K were compared under 532nm laser excitation with a power of 0.1mW. Three distinct peaks can be clearly observed in the spectrum of the exfoliated WS_2 bilayer, and two distinct peaks appearing in the low-energy region (around 1.75 eV) are indicated as two indirect transition peaks (X_I) in the WS_2 bilayer, A strong peak appears at the energy of 2.056 eV, which is the A-exciton peak (X_A) of the WS_2 bilayer[1, 2]. Interestingly, the PL spectra of the exfoliated WS_2 bilayer and the WS_2/WS_2 homostructure with a twist of 1.46° are significantly different. There are many split small peaks in the PL spectrum of the twisted homostructure region, and 9 split small peaks are obtained by fitting the spectrum by the Lorenzian function, and their central energies from low to high are 1.909 eV, 1928 eV, 1.946 eV, 1.967 eV, 1.988 eV, 2.004 eV, 2.026 eV, 2.044 eV and 2.060 eV. The results show that the peak spacing between the splitting peaks is almost constant at 19 ± 3 meV, which is similar to the moiré excitons reported by Tran et al[3].

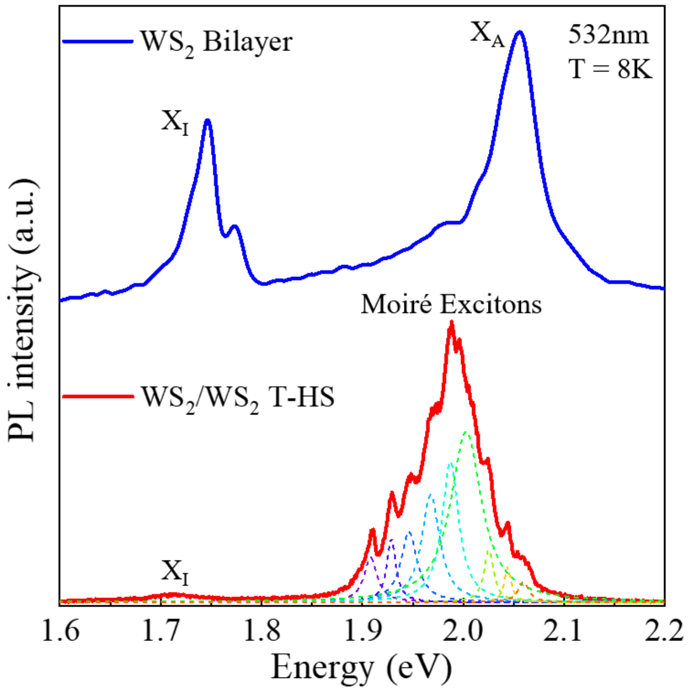

Figure S1. PL spectra of exfoliated bilayer and twisted homostructure (1.46°) at 8K under 532 nm laser excitation with a power of 0.1 mW. The PL spectrum of the twisted homostructure was fitted by Lorenzian function to obtain 9 split small peaks. The different exciton types are marked on the pl spectrum.

As shown in Figure S2, two peaks were obtained by fitting the PL spectrum of the WS_2 monolayer at 300 K by the Lorenzian function, with central energies of 1.985 eV and 2.031 eV, denoted as negatively charged trion and neutral excitons, respectively. The full width at half maximum of the neutral exciton PL peak extracted at room temperature is relatively narrow, which is 33 meV.

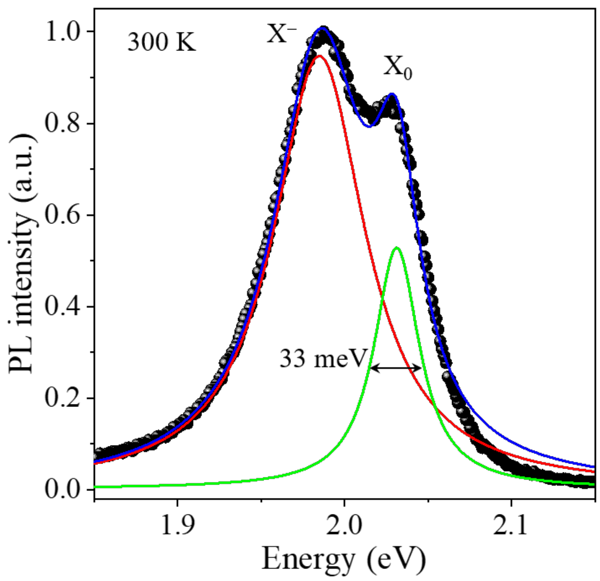

Figure S2. PL spectrum of monolayer WS_2 at 300 K. The red and green solid lines represent the negatively charged trion (X^{-}) and neutral exciton (X_0) peaks of the WS_2 monolayer obtained by Lorenzian function fitting, respectively.

Figure S3 shows the PL spectra of monolayer WS_2 as a function of temperature, varying from 8 K to 300 K. As the temperature decreases, the emission peak exhibits an obvious blue shift, and the blue dotted line represents the variation trend of exciton energy with temperature. Different exciton types are marked on the 8 K PL spectrum.

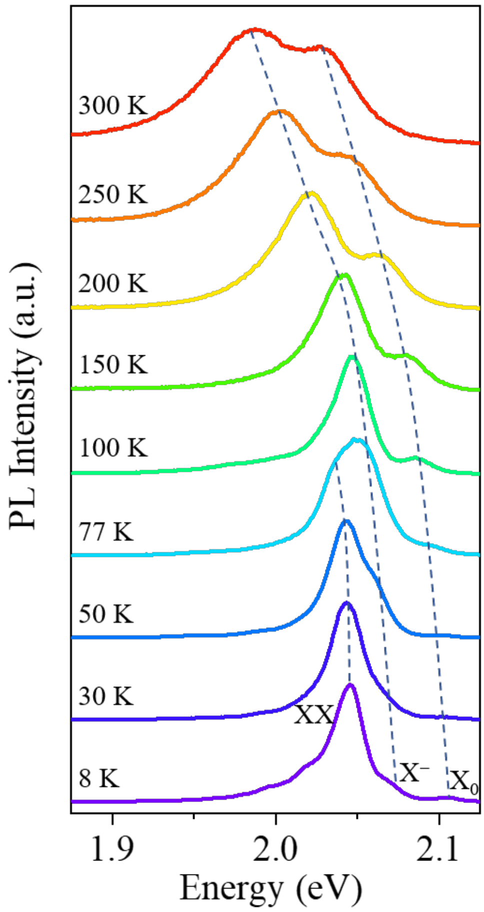

Figure S3. Temperature-dependent normalized PL spectra of monolayer WS2 (8K~300K). The blue dotted line represents the variation trend of exciton energy with temperature. The exciton type corresponding to each PL peak is marked on the PL spectrum as neutral excitons (X_0), negatively charged trions (X^-) and double excitons (XX).

References

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