Trion-Induced Distinct Transient Behavior and Stokes Shift in WS_2 Monolayers

Peng Fan[a], Biyuan Zheng[a], Xingxia Sun[b], Weihao Zheng[a], Zheyuan Xu[a], Cuihuan Ge[a], Yong Liu[a], Xiujuan Zhuang[a], Dong Li[b], Xiao Wang[a], Xiaoli Zhu[a], Ying Jiang[a], Anlian Pan*[b]*

a. Key Laboratory for Micro-Nano Physics and Technology of Hunan Province, School of Physics and Electronics, Hunan University, Changsha 410082, People's Republic of China.

b. Key Laboratory for Micro-Nano Physics and Technology of Hunan Province, College of Materials Science and Engineering, Hunan University, Changsha 410082, People's Republic of China.

AUTHOR INFORMATION

Corresponding Author:

Anlian Pan: anlian.pan@hnu.edu.cn

Ying Jiang: jying@hnu.edu.cn

1. AFM Image

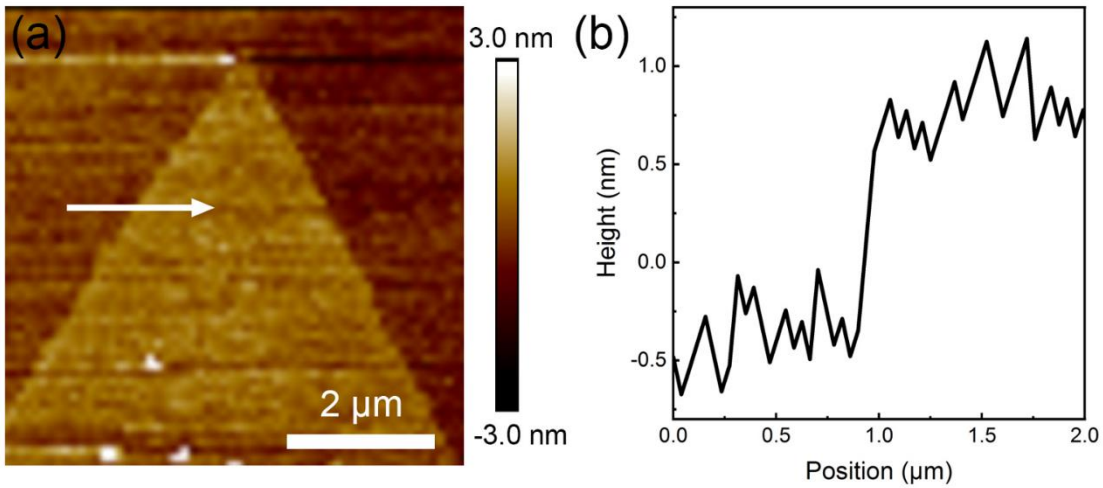

Fig. S1 The AFM image of WS_2 monolayer as-grown on Si/SiO_2 substrate (a) and the line profile (b) as the line marked on (a).

2. Steady-state Absorption Spectra

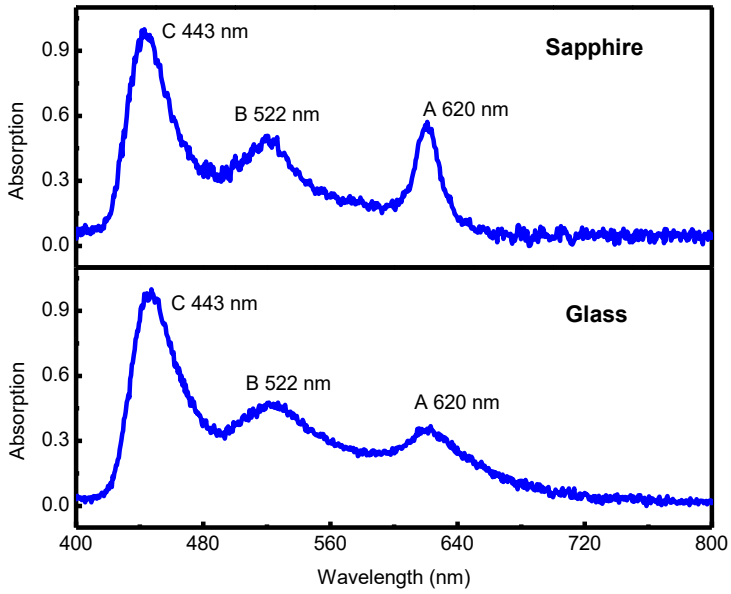

Fig. S2 The steady state absorption spectra of WS_2 monolayer transferred onto (a) sapphire and (b) glass substrates, respectively.

3. Normalized PL Spectra

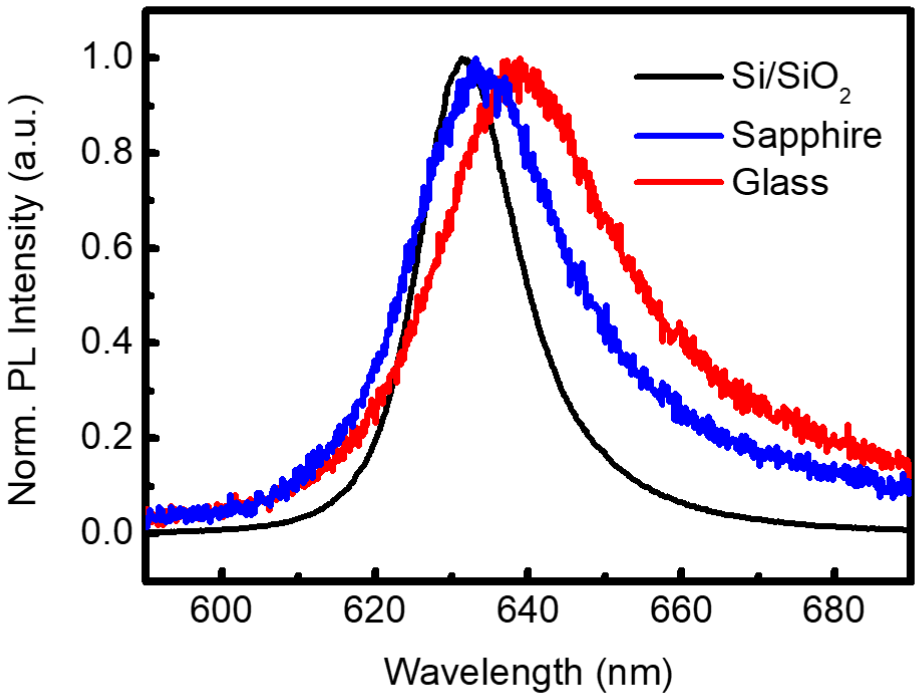

Fig. S3 The normalized PL spectra of WS_2 monolayer as-grown on Si/SiO_2 substrate (black), transferred onto sapphire (red) and glass (blue) substrates, respectively.

4. **Steady-state Absorption Spectra (inverted for comparison) and DAS Components**

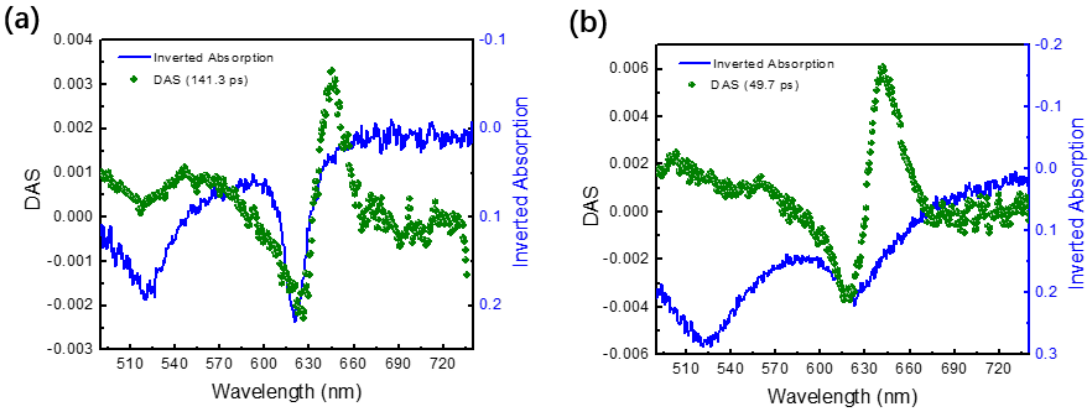

Fig. S4 The steady-state absorption spectra (inverted for comparison) and the DAS components responsible for exciton recombination in WS_2 monolayers on sapphire (a) and glass (b) substrates, respectively.

5. **The Fast Two DAS Components from the Global Fitting**

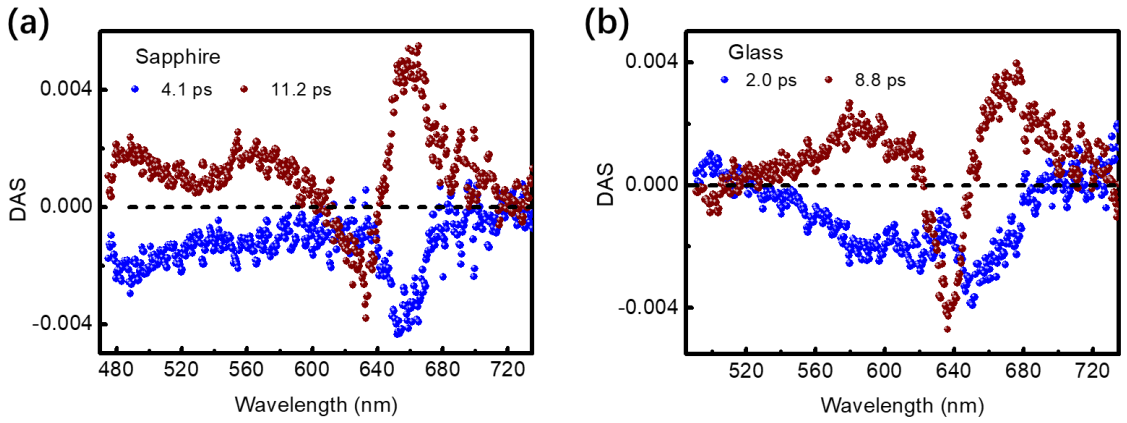

Fig. S5 The fast two DAS components in WS_2 monolayers on sapphire (a) and glass (b) substrates, respectively.