PHOTOLUMINESCENCE STUDY OF B-TRION IN CVD GROWN MoS_2 MONOLAYERS

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Two-dimensional semiconductors, namely, transition metal dichalcogenides (TMD) like MoS_2 have interesting physical properties, such as direct bandgap and very high exciton binding energy. The value of spin-orbit valence band splitting in MoS_2 is 146 eV [1]. Due to spin-orbit splitting, the monolayer of MoS_2 has two excitonic bands named *A* and *B* bands. The monolayer of MoS_2 has electrically neutral quasiparticles – excitons and if additional charges (electrons or holes) are present either negative or positive charged excitons – trions [2].

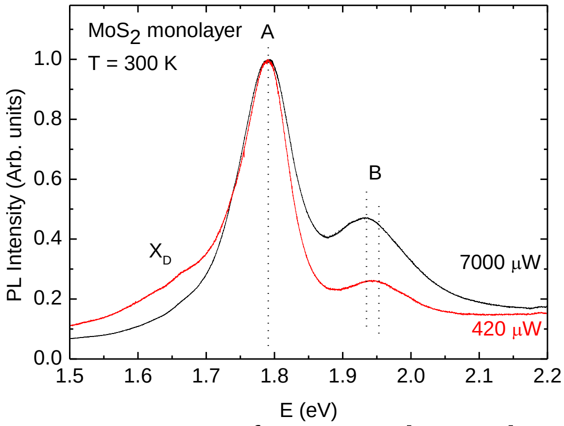

Fig. 1 PL spectra of MoS_2 monolayer at laser intensities 420 μW and 7000 μW.

Chemical vapour deposition (CVD) method was used to synthesize MoS_2 monolayers on Si/SiO_2 substrate. Different growth regimes were used and the most optimal regime gave MoS_2 monolayers with size ~100 μm. These monolayers were studied using non-resonant and resonant Raman scattering and laser dependent photoluminescence (PL). PL spectra show *A* and *B* bands and a defect peak X_D at lower energies (Fig. 1). Defect peak X_D is more pronounced at lower laser intensities. The *A* band has a peak maximum at around 1.78 eV, which is at lower energy compared to mechanically exfoliated MoS_2 monolayers. This shift is caused by a tensile strain in CVD grown MoS_2 monolayers. By increasing the laser intensity, the *B* band maximum shifted toward lower energy. This behaviour of the *B* band has not been detected before and this indicates that the *B* band consists of the *B* exciton peak and the B^+ trion peak with an energy difference about 25 meV.

References

[1] A. Ramasubramaniam, 2012, *Phys. Rev. B - Condens. Matter Mater. Phys.*, 86, 1–6.

[2] M. Drüppel, T. Deilmann, P. Krüger, and M. Rohlfing, 2017, *Nat. Commun.*, 8, 2117.

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