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Towards Intrinsic Optical Properties of Transition Metal Dichalcogenides

Transition metal dichalcogenides (TMDs) have drawn attention due to their potential applications for electronics, optoelectronics, and spintronics. Moreover, TMDs show many novel physical phenomena such as high order excitonic species. In order to explore such intrinsic properties of TMDs, reducing point defect is needed because of their high density of point defect. It has been known that defect density of TMDs is reported as 10^{12}-10^{13} cm^{-2} with Chemical Vapor Deposition (CVD) [1] and 10^{12} cm^{-2} with Molecular Beam Epitaxy (MBE) [2] or Chemical Vapor Transport (CVT) [3] technique. In this study, we have reduced point defect density of $MoSe_2$ and WSe_2 to mid10^{10} - low10^{11} cm^{-2} by using self-flux method for growing TMD crystals. Investigating the cleaner $MoSe_2$ and WSe_2 allow us to study their intrinsic optical properties. With gate dependent photoluminescence (PL), we have shown clean high order excitonic species such as biexciton and negatively charged biexciton with low laser fluence in WSe_2. Narrow linewidth and 100 times higher integrated PL in flux $MoSe_2$ compared to those in CVT $MoSe_2$ also show their properties are getting closer to their intrinsic properties.

References

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Figures

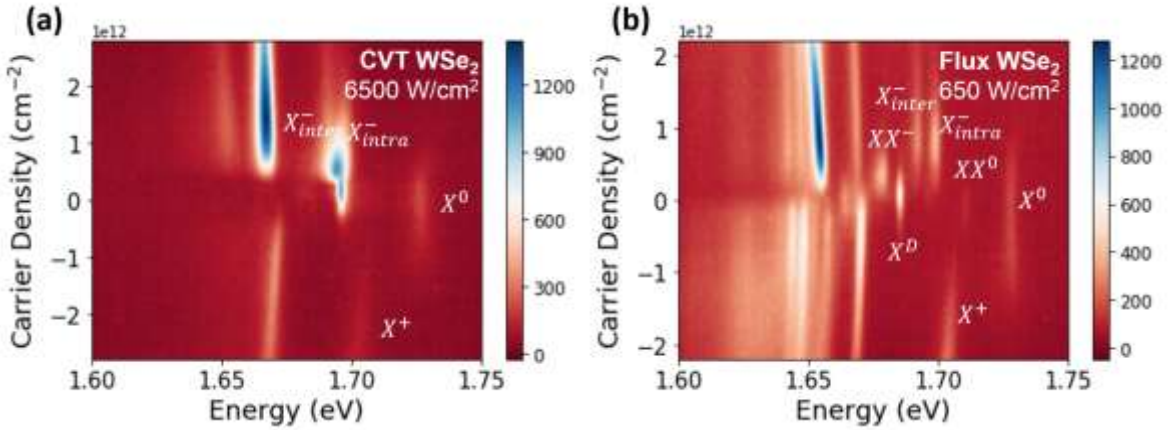

Figure 1: Gate dependent PL images of (a) CVT WSe_2 taken with a laser fluence of 6500 W/cm^2 (b) flux-grown WSe_2 taken with a laser fluence of 650 W/cm^2