Optical Properties of Moiré excitons in WS_2-$MoSe_2$ heterostructures

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Abstract

Twisted van der Waals (vdW) heterostructures exhibit periodic variations, leading to a new type of in-plane superlattice known as moiré superlattice/pattern which modifies considerably the optical properties of excitons in transition metal dichalcogenides (TMD) vdW heterostructures. The period of these moiré superlattices is determined by the lattice constant mismatch and the twist angle between the two layers [1]. In most of the cases, the vdW heterostructures have a type-II band alignment [1]. The strong Coulomb interaction in TMD materials gives rise in the formation of interlayer moiré excitons (IEs) with electrons and holes located in different TMD layers [1]. Furthermore, there are also vdW heterostructures where the electron (or hole) wavefunction is distributed over both layers and these excitons are referred to as hybrid excitons [1-3].
Here, we report on the impact of the moiré pattern on the magneto-optical properties of a WS_2/$MoSe_2$ heterobilayer with twist angles of approximately 0° and 60 $^\circ$ under perpendicular magnetic fields up to 20 T. We observed two neutral exciton peaks in the PL spectra: the lower energy one exhibits a reduced g-factor relative to that of the higher energy peak, and much lower than the recently reported values for interlayer excitons in other vdW heterostructures such as WSe_2-$MoSe_2$ [4]. In addition, similar values of g-factors are obtained for samples with twist angles of approximately 0° and 60° which indicates a weak hybridization between the intralayer and interlayer excitons for this heterostructure. In general, our results provide evidence that such a discernible g-factor stems from the spatial confinement of the exciton in the potential landscape created by the moiré pattern, due to lattice mismatch and/or inter-layer twist in heterobilayers[4].

References

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