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Spectrocopic Studies of Monolayer $MoSe_2$ on Strongly-Correlated Manganese Oxide

Due to the direct bandgap coupled with spin-valley degree of freedoms [1], two-dimensional (2D) semiconducting transition metal dichlcogenides have attracted much attention. Very recently, the artificial hetero-structure based on monolayer transition metal dichlcogenides and various 2D materials such as insulators, ferromagnetic semiconductors and metals were extensively studied. Among these, a strongly correlated manganese oxides exhibits unique magnetic and carrier transport properties. Hence, it is interesting to explore excitonic physics in new artificial hetero-structure with manganese oxides.

In this work, we conducted spectroscopic studies of artificial hetero-structure of monolayer (1L) $MoSe_2$ and manganese oxide ($La_{1.2}Sr_{1.8}Mn_2O_7$). The $La_{1.2}Sr_{1.8}Mn_2O_7$ is a ferromagnetic metal below T_C = 126 K, and shows large negative magnetoresistance [2]. The temperature dependence of photoluminescence (PL) spectra of hetero-structure (1L-$MoSe_2$/$La_{1.2}Sr_{1.8}Mn_2O_7$) and reference (1L-$MoSe_2$/SiO_2) were measured in our experiments. Figure 1(a) shows the PL spectra of 1L-$MoSe_2$ in the hetero- and reference-structure at 10 K. In the both spectra, the two-emission peaks from exciton (X) and charged exciton (X^-) were observed. Figure 1(b) shows the temperature dependence of PL intensity ratio of X^- and X (I_{X^-}/I_X) in the hetero-structure and reference. We observed that significant difference of PL intensity ratio of X^- and X in the hetero-structure and reference, which suggests that doped carrier density of 1L-$MoSe_2$ is much different in the hetero-structure and reference, because the PL intensity of X^- reflects the doped carrier density. We also discussed the excited state dynamics within the framework of an exciton and a trion in the hetero-structure [3]. Besides, we will discuss the valley splitting under low magnetic field based on the 1L-$MoSe_2$/hexagonal boron nitride (hBN)/Manganese oxide.

References

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Figures

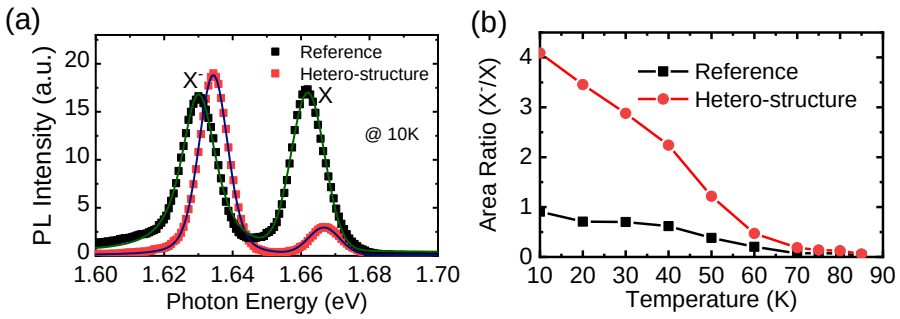

Figure 1: Figure 1(a) PL spectra of hetero-structure and reference at 10 K. (b) Integrated area ratio of trion(X^-) and exciton(X) versus temperature.