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Magneto Optical properties of monolayer $MoWSe_2$

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Abstract

Two-dimensional (2D) semiconductors, such as transition-metal dichalcogenide (TMD) monolayers, have attracted great attention in the last years because of their direct band gap, valley properties and excitonic effects [1-3]. Particularly, TMD alloys with different compositions are also interesting systems to the engineering of their physical properties which has great importance for their potential applications. Although spin-orbit engineering is already well known for monolayer TMD alloys, their valley Zeeman physics remains still unexplored [1]. In this work, we report on a detailed study of photoluminescence (PL) and magneto-photoluminescence under perpendicular magnetic field (up to 9 T) on a monolayer $Mo_{0.5}W_{0.5}Se_2$ encapsulated with hBN. The nature of the emission peaks, the magnetic field dependence of polarization degree and g-factors are investigated in detail. We have observed two emission bands at low temperature. The higher energy peak observed at around 1.69 eV was associated to the trion emission and the lower energy peak at around 1.61 eV was associated to localized states. The extracted g-factor of the trion emission peak has showed a large value $g_T \approx - 9.1$ which is much higher than their theoretical predictions in the literature [1]. This result was explained by doping effects on the magnetic-field dependence of the trion energy [1] . In general, our results suggest that TMD alloys are promising materials to explore fundamental physics and for possible application in optoelectronic devices.

References

[1] Lishu Wu, et al, ACS nano, 15(5), 8397-8406 (2021)
[2] Jan Kopaczek et al ACS Omega, 6, 19893−19900 (2021)
[3] Jialiang Ye et al, APPLIED PHYSICS LETTERS 111, 152106 (2017)

Figures

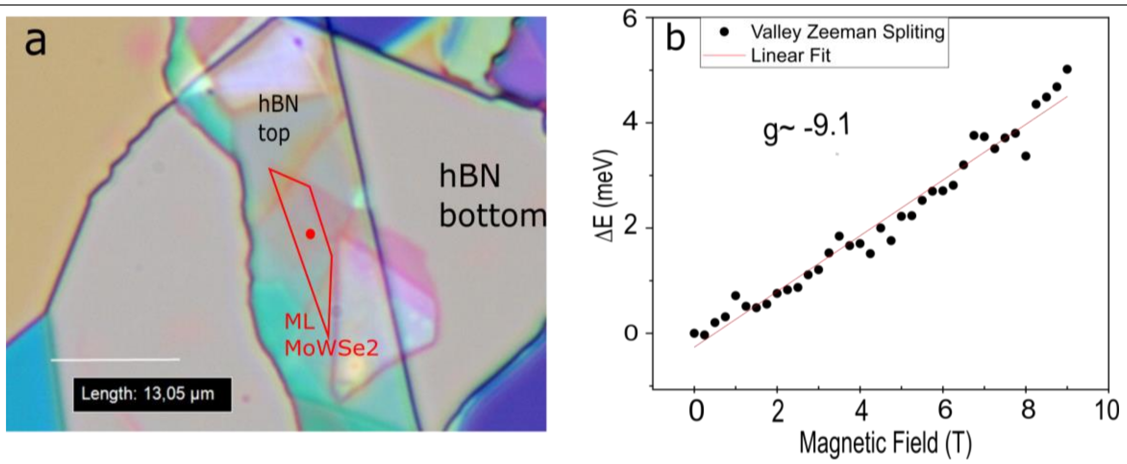

Figure 1: (a) Optical microscope image of the hBN encapsulated ML $Mo_{0.5}W_{0.5}Se_2$ (b) Magnetic field dependence of the valley Zeeman splitting at 3.6K.