Ting Yu
Nanyang Technological University
Singapore
yuting@ntu.edu.sg

Tuning Electronic and Valley Structures of Two-dimensional Semiconductors by Applying Electrical and Magnetic potentials

Two-dimensional (2D) semiconductors, such as transitional-metal-dichalcogenide monolayers (TMD 1Ls), have aroused great interest because of the underlying fundamental physics (e.g. many body effects and wealth excitonic states) and the promising optoelectronic applications such as light-emitting diodes and solar cells. Here, we report excitonic emission and valley splitting of monolayer WS2 and MoS2 under electrical, optical and magnetic manipulation. Through electrical and optical injection of charge carriers, tunable excitonic emission has been realized due to interplay of various excitonic states, and basic binding energies of trions have been extracted. At low temperature, the Zeeman shifts of excitons and trions have been determined by polarization-dependent photoluminescence measurements under perpendicular magnetic fields, which reveal the breaking of valley degeneracy. Our studies provide the fundamental understanding on large excitonic and unique valleytronic effects in TMD 1Ls. Moreover, we also develop multiple strategies for managing the light emission, which opens up many possibilities for improving the performance and creating the multifunction of 2D TMD-based light emitting applications.