Optical properties in monolayer transition metal dichalcogenide/layered antiferromagnet heterostructures

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Abstract:

Van der Waals heterostructure has attracted much interest because of its high extensibility by using various layered materials. Furthermore, the recent discovery of 2D magnets has provided us a new platform to investigate magnetic van der Waals heterointerfaces, leading to novel studies on spin-/valley-tronics [1].

Here we report a new type of magnetic van der Waals heterointerface using monolayer transition metal dichalcogenides (especially $MoSe_2$) and layered antiferromagnets ($MPSe_3$, M=Mn, Fe) which shows antiferromagnetic transitions with Neel- or stripe-type ordering (Fig. 1). We fabricated the samples by using all-dry-transfer method in inert atmosphere, then performed photoluminescence measurements at various temperature (Fig. 2). The characteristic peak shifts of the exciton observed below the transition temperature of the antiferromagnets, which suggests that the antiferromagnetic magnetic ordering on the bottom layer truly couples with the exciton on the top $MoSe_2$ directly and microscopically via interlayer exciton-magnon interaction [2].

Figures

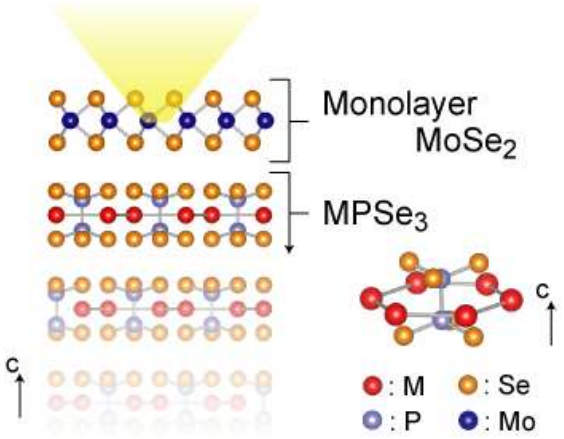

Figure 1: Sample configuration. Van der Waals heterostructure of monolayer $MoSe_2$ and $MPSe_3$, and photoluminescence measurements.

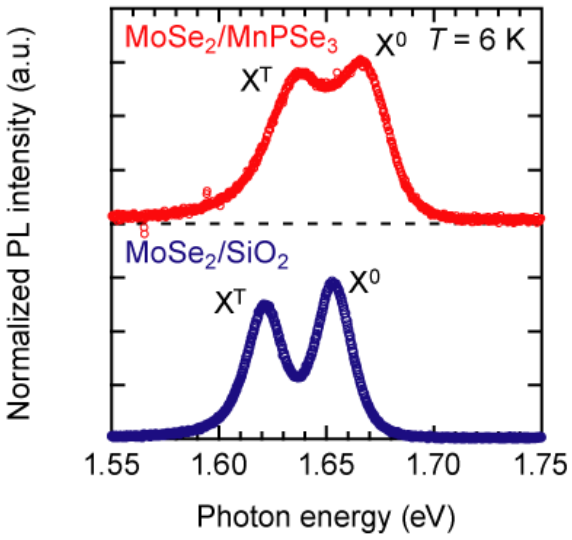

Figure 2: Photoluminescence spectra from an antiferromagnetic van der Waals heterointerface and a non-magnetic interface.

References

[1] D. Zhong *et al.*, Science Advances 3, e1603113 (2017).
[2] M. Onga et al., in preparation (2019).