Growth and structural characterization of vanadium selenide thin films grown by molecular-beam epitaxy

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Transition-metal dichalcogenide (TMDC) is a representative layered material providing unique and intriguing properties at monolayer limit originating from broken inversion symmetry and strong spin-orbit coupling. The researches on monolayer TMDCs have been mainly performed for semiconducting TMDCs like MoS_2 presenting valley-related phenomena as well as for metallic TMDCs like $NbSe_2$ and TaS_2 showing unconventional superconductivity as well as WTe_2 exhibiting quantum spin Hall effect. On the other hand, magnetic properties of TMDCs had been almost unexplored, while recent study on monolayer VSe_2 demonstrated room temperature ferromagnetism [1], providing an important step toward spintronics applications based on TMDCs. However, very recent study on angle-resolved photoemission spectroscopy and x-ray magnetic circular dichroism verified absence of ferromagnetic order in this compound above 10 K [2]. We have recently discovered that vanadium selenide epitaxial thin films grown by molecular-beam epitaxy based on our growth recipe exhibit peculiar magnetic properties with clear anomalous Hall effect at low temperature. In this presentation, we will introduce our sample fabrication process and discuss structural properties of our magnetic vanadium selenide epitaxial thin films.

[1] *Nat. Nanotechnol.* **13**, 289 (2018); [2] *Nano Lett.*, Article ASAP (DOI: 10.1021/acs.nanolett.8b01649).

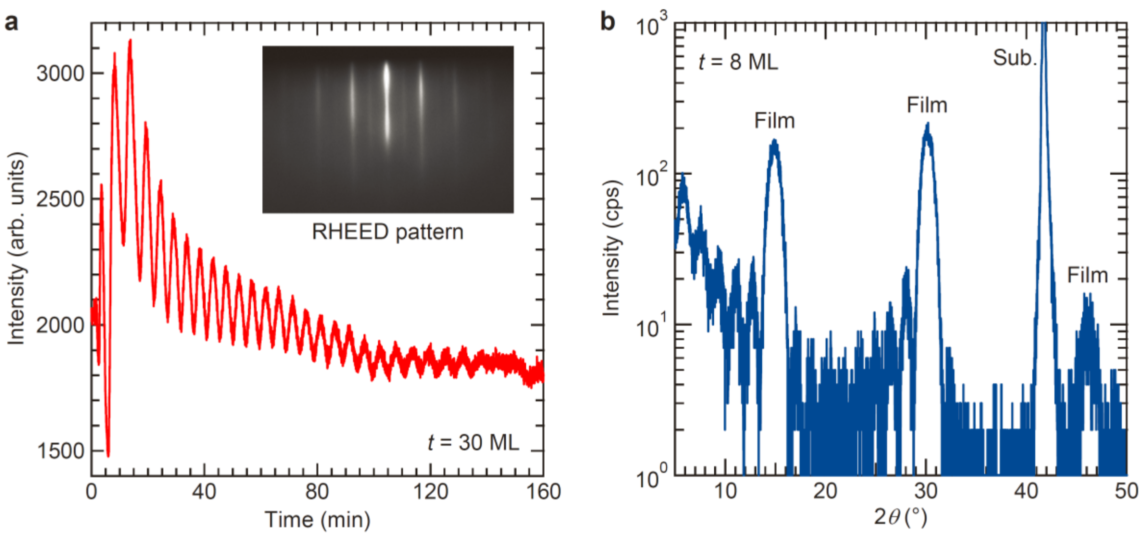

Figure 1: **a**, Typical RHEED intensity oscillation generally observed for epitaxial growth of vanadium selenide thin films and corresponding RHEED pattern taken after the growth. **b**, The out-of-plane x-ray diffraction pattern of a typical 8 monolayer-thick vanadium selenide epitaxial thin film.