Transport properties of single-crystalline $TiSe_2$ epitaxial thin films grown by molecular-beam epitaxy

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【**Abstract**】Transitional-metal dichalcogenides (TMDC) with reduced thickness are one of the most important branches in 2D materials researches due to their novel properties that are different from their bulk counterparts. 1T-$TiSe_2$, one of semiconducting TMDC with a negative band gap (*i.e.* a semimetal), possesses a charge-density wave (CDW) ground state with the transition temperature of about T = 200 K in a bulk, which is competitive to a superconducting phase. The dimensionality effect on the electronic properties of 1T-$TiSe_2$ has been examined by angle-resolved photoemission spectroscopy, but there is no report on transport properties at monolayer limit probably due to difficulty in fabrication of monolayer 1T-$TiSe_2$ by a conventional exfoliation technique. Here, we report on epitaxial growth of single-crystalline 1T-$TiSe_2$ thin films by molecular-beam epitaxy (MBE), and discuss their transport properties.

【**Results**】$TiSe_2$ epitaxial thin films were grown on sapphire by MBE with the layer-by-layer mode confirmed by reflection high energy electron diffraction (RHEED). The out-of-plane and in-plane x-day diffraction measurements confirmed good orientation both for out-of-plane and in-plane directions with the epitaxial relationship of $TiSe_2$ (001) // Al_2O_3 (001) and $TiSe_2$ [110] // Al_2O_3 [100]. The obtained 10-monolayer-thick $TiSe_2$ epitaxial thin films exhibited clear CDW transition at around T = 200 K with the sign change in the Hall coefficient, which is consistent to the behavior reported for bulk $TiSe_2$. In the presentation, we will introduce a growth process more in detail, and discuss dimensionality effect on the transport properties of the obtained 1T-$TiSe_2$ epitaxial thin films.

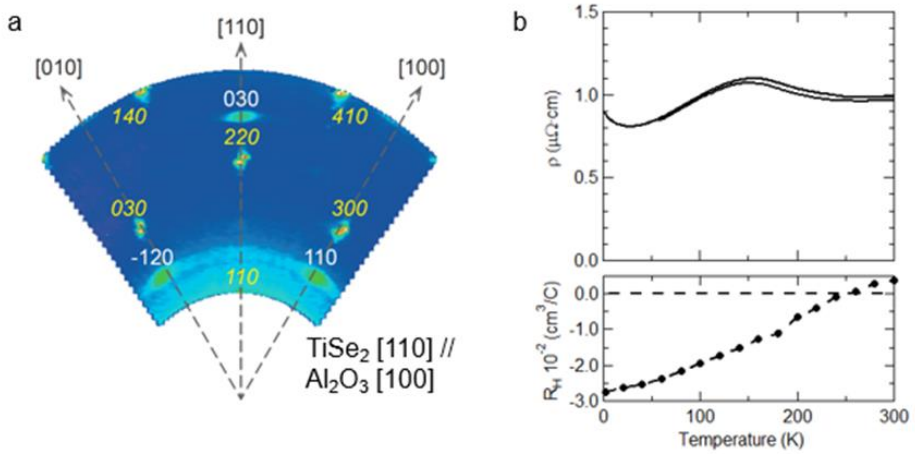

Figure 1: **a**, The reciprocal space map of the x-ray diffraction measurement within the (*hk*0) plane. **b**, (top) The longitudinal resistivity (ρ) and (bottom) the Hall coefficient (R_H) as a function of temperature confirming CDW transition near T = 200 K.