Tunable Curie temperature in two-dimensional chromium telluride films grown by molecular beam epitaxy

Dept. Appl. Phys., Univ. Tokyo[1], RIKEN CEMS[2], ◦Yue Wang[1], Masaki Nakano[1,2], Satoshi Yoshida[1], Hideki Matsuoka[1], Kyoko Ishizaka[1,2], Yoshihiro Iwasa[1,2]

E-mail: wangyue@ mp.t.u-tokyo.ac.jp

Material research in ferromagnetism has driven the development of data storage and spintronics. Recently, ferromagnetism in atomically-thin, layered two-dimensional (2D) van der Waals materials have been found on exfoliated insulating ferromagnets $Cr_2Ge_2Te_6$ [1] and CrI_3 [2]. In addition, another pioneering work has been demonstrated on 2D metallic ferromagnet Fe_3GeTe_2 [3], in which the Curie temperature can be tuned up to room temperature by electrostatic gating [4]. Those studies have opened huge application opportunities in 2D spintronics. Combining 2D ferromagnetism with related electronic and optical properties could further provide functionalities in magnetoelectric and magneto-optics fields. Among various 2D materials, transitional-metal dichalcogenides (TMDCs) has been showing great potential in electronic and optoelectronic applications, which makes it one of the most promising candidates. Recent study has also revealed possible room temperature ferromagnetism in VSe_2 [5], while there are still many discussions and enigma on ferromagnetism in TMDCs. We have been focusing on exploring novel properties in TMDC thin films using molecular-beam epitaxy (MBE) method. Recently we succeeded in growing atomically-thin chromium telluride epitaxial thin films on insulating sapphire substrates by MBE (Fig.1), and confirmed ferromagnet behavior (Fig. 2). In this presentation, we will introduce our growth recipe, then discuss structure and related transport and magnetic properties of those MBE-grown chromium telluride epitaxial thin films.

[1] C. Gong *et al., Nature* **546**, 265 (2017); [2] B. Huang *et al., Nature* **546**, 270 (2017); [3] Z. Fei *et al., Nat. Mat.* **17**, 778 (2018) [4] Y. Deng *et al., Nature* **563**, 94 (2018) [5] M. Bonilla *et al., Nat. Nanotechnol.* **13**, 289 (2018)

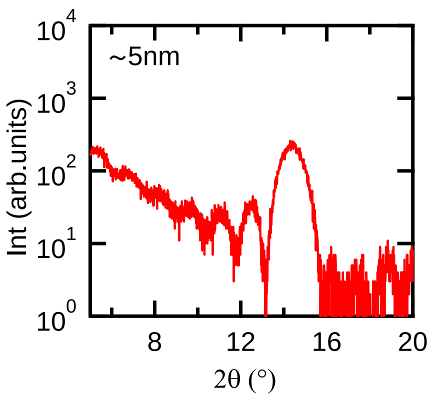

Fig. 1. XRD data of chromium telluride thin film

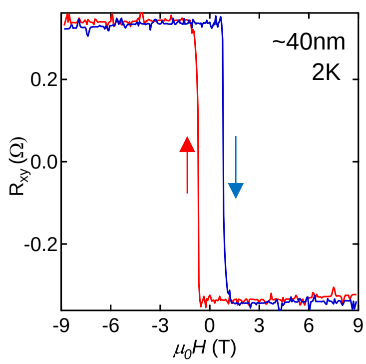

Fig. 2. Hall measurement in chromium telluride thin film