Growth of large-area Topological Insulators by Metal-Organic Chemical Vapor Deposition

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Recently, topological insulators (TIs) have attracted great attention because of their topologically-protected surface and/or edge states that can be used beneficially in several spintronic applications [1,2]. In the recent years, our group developed Metal-Organic Chemical Vapor Deposition (MOCVD) processes to grow nearly-epitaxial antimony telluride (Sb_2Te_3) [3], bismuth telluride (Bi_2Te_3) [4], and their combination [5], over large area (4") Si(111) substrates. Their topological character has been validated [5, 6], and large spin-charge conversion has been achieved at room temperature as probed by spin pumping ferromagnetic resonance [5,7,8].

Figure 1 shows the (a) scanning electron microscopy (SEM) image and (b) X-ray diffraction (XRD) pattern of a representative Sb_2Te_3 layer, as grown by using the antimony chloride ($SbCl_3$), and bis(trimethylsilyl)telluride($Te(SiMe_3)_2$) as precursors with the process described in [3]. Apart from SEM and XRD, all the MOCVD-grown TI are routinely probed also by XRR, atomic force microscopy, and (magneto)transport, in order to get a comprehensive view of their chemical, structural, morphological, and functional properties.

Within this contribution, I will present the MOCVD method we use to grow the TIs, providing a spotlight on the properties that are of importance towards their use in realistic spintronic devices.

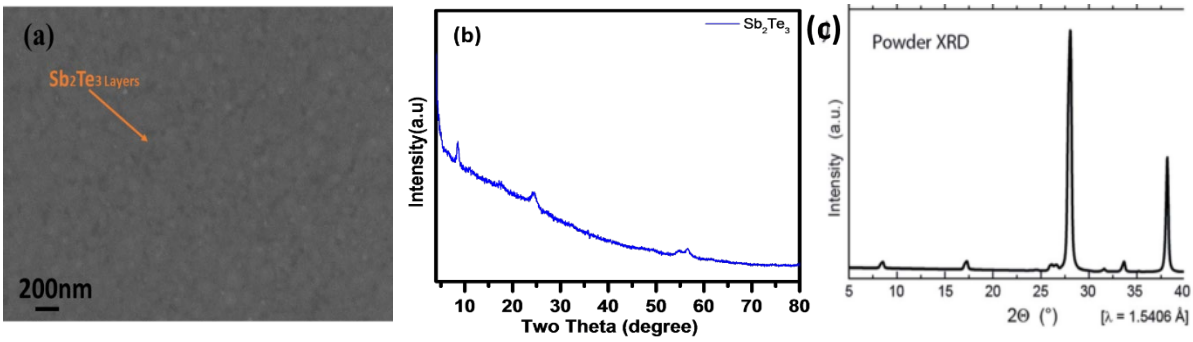

Fig. 1: (a) SEM image of epitaxial-quality Sb2Te3 thin film highlighting surface morphology, (b) Grazing incidence XRD pattern of Sb_2Te_3 as taken in the Bragg-Brentano configuration, (c) powder XRD pattern reference for Sb2Te3 measured at RT and atmospheric pressure[9].

References:

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