Development of large-area topological insulators on Silicon for spintronics

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Topological insulators (TIs) are gaining a huge attention from a technological point of view due to highly efficient spin-charge interconversion phenomena occurring at their interface with magnetic materials, which is of interest for spin-orbit torque MRAM [1] and novel processing-in-memory devices such as the MESO proposed by Intel [2]. We developed Metal Organic Chemical Vapour Deposition (MOCVD) processes to grow epitaxial-quality Sb_2Te_3 and Bi_2Te_3 3D-TIs on 4" Si(111) substrates [3-5], see Figure. 1. First, their topological character has been demonstrated by combining magnetotransport and angular photoemission spectroscopy studies [6]. Then, we built simple spin-charge converters by interfacing the TIs with ferromagnetic layers (FM=Fe,Co). Within this talk, we report a large spin-charge conversion efficiency in the FM/Sb_2Te_3-based systems, as expressed in terms of the generated inverse Edelstein Effect (λ_{IEE}) extracted from spin pumping ferromagnetic resonance (SP-FMR) [7,8]. Values of λ_{IEE} up to 0.61 nm were measured [8], indicating quite a large conversion efficieny within the class of second generation 3D chalcogenide-based Tis (Figure 2). Our results open interesting routes toward the use of chemical methods to produce TIs over large area Si substrates and characterized by highly performing spin-to-charge conversion, thus marking a milestone toward future technology-transfer.

References

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Figures

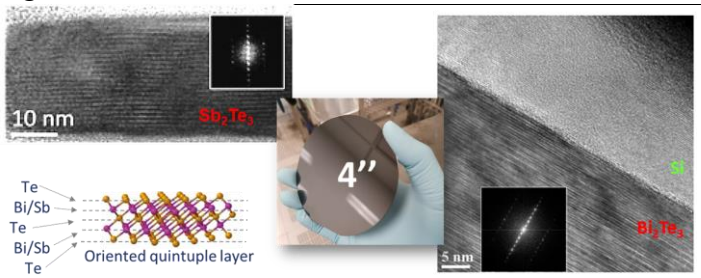

Figure 1: Transmission electron microscopy images of MOCVD-grown TIs on 4'' Si(111).

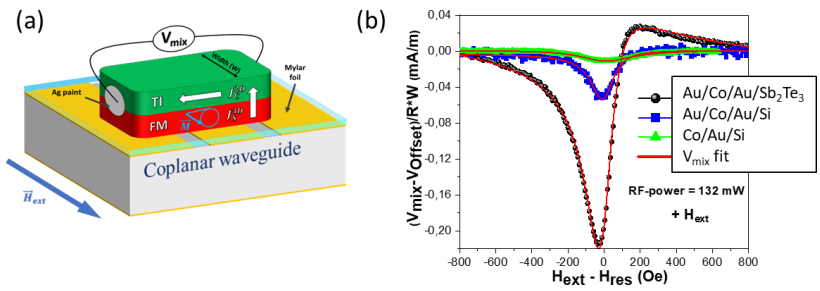

Figure 2: SP-FMR (a) sample's configuration and (b) results obtained in Au/Co/Au/Sb_2Te_3/Si(111) spin-charge converter.