NewTimes – New Trends in Materials Science and Engineering
1st International Virtual Conference
14-18 June 2021

SESSION: *New trends in nanotechnology, nanostructures and nanoscience*
Preference: ORAL presentation

Large spin-to-charge conversion at room temperature in extended epitaxial Sb_2Te_3 topological insulator chemically grown on Silicon

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Spintronics is nowadays a promising reality to produce innovative and highly efficient electronic devices, where the study of non-conventional topological phases of matter is attracting huge interest.[1] Recently, the integration of 3D topological insulators (TI) with ferromagnetic thin films (FM) is gaining remarkable results in the context of spin-charge conversion (SCC), showing an efficiency in FM/TI heterostructures which can be higher than in similar systems where TI are substituted by heavy metals. For a realistic adoption of TI in the industrial framework, their high chemical-structural quality and large-area deposition are demanding. Here, we demonstrate the possibility to grow epitaxial TI Sb_2Te_3 thin films by Metal Organic Chemical Vapor Deposition on 4'' Si(111) wafers.[2] Moreover, to investigate on the SCC in Sb_2Te_3-based systems, Au/Co and Au/Co/Au stacks are deposited on top of the Sb_2Te_3 substrate, and the dynamic of the magnetization studied by means of ferromagnetic resonance spectroscopy (FMR) as a function of the Co thickness. The FMR data for the Au/Co/Sb_2Te_3 samples evidenced a dominant contribution of the Two Magnon Scattering (TMS) effect, likely due to the presence of unwanted magnetic roughness at the Co/Sb_2Te_3 interface. The introduction of the Au interlayer to avoid the direct contact between Co and Sb_2Te_3 layers was shown to be beneficial for the total suppression of the TMS effect. Spin pumping – FMR measurements conducted at room temperature showed a high SCC in the optimized Au/Co/Au/Sb_2Te_3 heterostructure, measuring inverse Edelstein effect lengths that are comparable or higher than those obtained so far for the second generation of 3D chalcogenide-based TI.[3] Our results open the path towards the use of chemical methods to produce TI on large area Si substrates and characterized by highly performing SCC, thus marking a milestone for the future technology-transfer.

Bibliography

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