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Bismuth Telluride Topological Insulator: Physical Vapor Transport vs Molecular Beam Epitaxy

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Abstract : Topological insulator (TI) materials are insulating in the bulk and conducting in the surface. The unique electronic properties associated with these surface states make them strong candidates for exploring innovative quantum phenomena and as practical applications for quantum computing, spintronic and nanodevices. Many materials, including Bi_2Te_3, have been proposed as TIs and, in some cases, it has been demonstrated experimentally by angle-resolved photoemission spectroscopy (ARPES), scanning tunneling spectroscopy (STM) and/or magnetotransport measurements. A clean surface is necessary in order to make any of this measurements. Several techniques have been used to produce films and different kinds of nanostructures. Growth and characterization in situ is usually the best option although cleaving the films can be an alternative to have a suitable surface. In the present work, we report a comparison of Bi_2Te_3 grown by physical vapor transport (PVT) and molecular beam epitaxy (MBE). The samples were characterized by X-ray diffraction (XRD), Scanning electron microscopy (SEM), Atomic force microscopy (AFM), X-ray photoelectron spectroscopy (XPS) and ARPES. The Bi_2Te_3 samples grown by PVT, were cleaved in the ultra-high vacuum in order to obtain a surface free of contaminants. In both cases, the XRD shows a c-axis orientation and the pole diagrams proved the epitaxial relationship between film and substrate. The ARPES image shows the linear dispersion characteristic of the surface states of the TI materials. The samples grown by PVT, a relatively simple and cost-effective technique shows the same high quality and TI properties than the grown by MBE.

Keywords : Bismuth telluride, molecular beam epitaxy, physical vapor transport, topological insulator
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