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LEED and TEM analysis of Bismuth Telluride

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Bismuth Telluride has recently been identified as a 3D-topological insulator [1] as well as Graphene [2]. Topological insulators are a quite recent discovered quantum mechanics characteristic of materials where essentially the surface band structure is completely different from the bulk. Bismuth Telluride, for example has its semi-metallic behavior changed into a conducting one. However it has been well known, as an excellent thermoelectric material [3]; with relatively high thermoelectric coefficients at room temperature. Bismuth Telluride is a relatively easy material to obtain and different compositions are being studied both as bulk material and as thin films. Crystals of Bi2Te3 were Bridgman grown in a sealed quartz ampoule in a directional resistance oven at a temperature of 600oC. Conventional X-ray Laue diffraction showed patterns compatible with a single crystal along the sample except for the starting point, which was discarded. Transmission and Scanning Electron Microscopy and Low Energy Electron Diffraction (LEED) were performed. The grown crystals were cleaved and small parts were crushed on a mortar with ethanol and deposited onto a holey carbon grid. Also thin slices were cut in an ultramicrotome (Leica UC6) with a diamond knife and deposited onto a holey carbon coated grid. TEM measurements showed the presence of grains on both samples with a very small deviation from the observed crystallographic axis (0001). However LEED measurements showed only a single crystalline pattern. Electron backscatter diffraction (EBSD) studies showed large granular areas with a extremely small angular variation between the grains. It is still unclear if those differences are real or due to sample preparation artifacts and effort is being put into analyzing exactly the same piece with all the different techniques.

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