Characterization of SnTe Nanowires and Nanoplates Grown by MBE on Graphene

Piotr Dziawa [1], Janusz Sadowski [1,2,3], Sławomir Kret [1], Anna Kaleta [1], Wojciech Knoff [1], Marcin Wojtyniak [4] and Tomasz Story [1]

[1] *Institute of Physics, Polish Academy of Sciences, Warsaw, Poland*
[2] *MAX-IV laboratory, Lund University, Sweden*
[3] *Department of Physics and Electrical Engineering, Linnaeus University, Kalmar, Sweden*
[4] *A. Chełkowski Institute of Physics, University of Silesia, Katowice, Poland.*

SnTe belongs to the family of topological materials classified as topological crystalline insulators (TCI), where topological protection of boundary states (surface states in the case of a bulk material) is due to {110} mirror-plane symmetry of rock-salt crystal structure of these narrow bandgap IV-VI chalcogenides. In this aspect TCIs differ from the "classical" TIs from $Bi_2(Te,Se)_3$ family, where emergence of topological protection of the surface electronic states is due to the time reversal symmetry and strong spin-orbit interactions. TCIs were first proposed theoretically by Liang Fu [1,2] and shortly afterwards confirmed experimentally for (Pb,Sn)Se [3] and (Pb,Sn)Te [4] solid solutions, and also for the "parent" binary compound - SnTe [5].

Here we report on the MBE growth of nanostructures – nanowires (NWs) and nanoplates (NPLs) deposited on graphene/SiC. The NWs were crystallized using a classical method of Au-catalyzed vapour-liquid-solid (VLS) MBE growth using SnTe compound source. The NPL emerged occasionally as a "by-product" of NWs growth and are not associated with the VLS growth mechanism.

The NWs crystallize in the rock-salt structure, typical for bulk SnTe; they grow along [001] crystalline direction which implies their square cross-sections, and they are entirely defect–free. The lengths of NWs are in the range of 0.5 to 2 μm. Typical thickness of shorter NWs is around 50 nm. Occasionally very thin (about 10 nm in cross-section) and long (up to 3 μm) NWs are formed. The triangle shaped NPLs emerge sporadically at the surface in-between NWs and the mechanisms of their formation are not fully understood.

The selected samples were processed by focused ion beam (FIB) and extensively studied by SEM, and aberration corrected TEM. With the latter both crystalline structure and composition of NWs and NPLs have been investigated. Electrical properties of the as-grown samples were studied using local conductivity AFM. The results showed, that both NWs and NPLs exhibit very high conductance, which may be due to contribution of topologically protected surface states.

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