Preliminary Magnetotransport Studies of the $MoTe_2$ Layers Grown by Molecular Beam Epitaxy

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The transition metal dichalcogenides are promising materials due to their unusual magnetic, optical and electrical properties. As it has been recently shown, Weyl semimetal including $MoTe_2$ can exhibit carrier mobility of 4000 cm^2/Vs and giant magnetoresistance (MR) of 16 000% in a magnetic field of 14 T at 1.8 K [1]. Most of the transport results of the $MoTe_2$, a relatively unexplored transitional metal dichalcogenide, are obtained on mechanically exfoliated samples and concern only temperature dependence of resistance [2-3]. Nowadays, there is a substantial progress in obtaining $MoTe_2$ by thin-film epitaxy or deposition [4-8]. In this paper, we present the preliminary studies of the $MoTe_2$ layers grown by molecular beam epitaxy (MBE) on GaAs substrates which can be easily adapted to electronic and spintronic devices.

We have grown two types of $MoTe_2$ – an amorphous one on oxidized GaAs [100] substrate and pure, semiconducting alpha phase (2H) $MoTe_2$ on semi-insulating GaAs [111B] substrate. 2H-$MoTe_2$ phase, clearly visible in reflection of high-energy electron diffraction (RHEED) during the growth, was isolated from GaAs [111B] surface by 25 nm of ZnTe. The surface morphology of the samples have been characterized by optical and scanning electron microscope (SEM) revealing a good sample morphology down to one micrometer scale. We have made the indium contacts using a vacuum evaporation achieving a number of samples in a reproducible process. The investigations of current-voltage characteristics and four-probe transport measurements of the semiconducting and amorphous $MoTe_2$ layers showed their high resistivity at room temperature ($\rho_{\square} \sim 2 \cdot 10^8\ \Omega/\square$), more than previously observed [7].

We systematically studied the current-voltage dependences for samples of different thickness grown on two different substrates. The role of the substrate on sample properties will be discussed.

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