Band Structure and New Magneto-transport Properties in HgTe/CdTe Superlattice.

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We report here the band structure and new magneto-transport results for HgTe (180 Å) / CdTe (44 Å) superlattice grown by molecular beam epitaxy. Calculations of the specters of energy $E(k_z)$ and $E(k_p)$, respectively, in the direction of growth and in plane of the superlattice; were performed in the envelope function formalism. Carriers transport properties were studied in the temperature range 1,5-300 K in magnetic field up to 8 Tesla. The angular dependence of the transverse magnetoresistance essentially follows the two-dimensional (2D) behaviour until 2,7 Tesla and saturate. However, a non-vanishing magnetoresistance is observed when the field is parallel to the plane. While the Hall voltage goes to zero at this configuration. At low temperature, the sample exhibits p type conductivity with a hole mobility of 900 cm^2/Vs. A reversal of the sign of weak-field Hall coefficient occurs at 25 K. It may be attributed to trapping of carriers on resonant states yielding to an electron mobility of 3 10^4 cm^2/Vs. The formalism used here predicts that the system is semimetallic when the HgTe to CdTe thickness ratio d_1/d_2 is greater than 4. In our case, $d_1/d_2 = 4.1$ and the gap E_g (Γ, 4.2 K) = 3 meV corresponding to thermal energy necessary to change the sign of weak-field Hall coefficient. In intrinsic regime, the measured $E_g \approx 38$ meV is in good agreement with calculated E_g (Γ, 300 K) = 34 meV witch coincide with the Fermi level energy. In spite of it, the sample exhibits the features typical for the semimatallic conduction mechanism which agree well with the overlap between carrier's subbands in the plane of the superlattice and is a far-infrared detector (50 µm< λ< 450 µm). Note that we had observed a p-type conduction mechanism with Seebeck and Shubnikov-de Haas effects in medium-infrared detector, narrow gap and two-dimensional semiconductor HgTe (56 Å) / CdTe (30 Å) superlattice [1].

[1] A. Nafidi, A. El Abidi and A. El Kaaouachi, AIP Conference Proceedings 850, New York: American Institute of Physics, 2006, pp.1359-1361.

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