Electronic structure, effective mass and magneto-transport properties in HgTe-CdTe superlattice with large quantum well thickness

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ABSTRACT
We have carried out the bands structures, effective masses and magneto-transport results in HgTe (d1=40 nm) / CdTe (d2=15 nm) superlattice (SL). Bands structures E(d2), E(kz) and E(kp), respectively, in the direction of growth and in plane of the super lattice; were performed in the envelope function formalism. The angular transverse magnetoresistance p/ρ0 (B) follows the two-dimensional (2D) dependence. A reversal of the sign of the Hall coefficient at 4.2 K occurs at about 3.2 T. It may be inferred to the existence of, at least, two types of carriers which suggests a semimetallic conduction. The Boltzmann equation of Hall constant Rn(B) lead to an electron mobility μn=6700 cm²/Vs and a concentration n=6.2 \times 10^{11} \text{ cm}^{-2} \text{ (with}} \ μn/μp=15 \text{ and } p/n=42).

Keywords: Bands structure, magneto-transport properties, narrow gap, far-infrared detector, HgTe/CdTe superlattice.

Motivation
The aim of this work is the research of correlation between magneto-transport properties and band structure E (d2), E (kz) and E (kp).

Results and Discussion
The energy E(d2, Γ, 4.2 K), shown that when d2 increase the band gap E2 decrease to zero at the transition semiconductor to semimetal conductivity behaviour (at the dot T(d2T =10 nm, EΓ=38 meV)) and become negative accusing a semimetallic conduction. At low temperatures the sample exhibits n type conductivity. After 3.2 T the mobility is assumed by the holes conduction.

Conclusion
The theoretical and magneto transport parameters are in good agreement for our sample with narrow gap near the dot T. Our study reveals that this sample is a narrow gap semimetallic, two-dimensional and far-infrared detector (204 \ μm<λ<430 \ μm).

References