Parallel transport in PbTe/PbEuTe quantum wells

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Abstract:

PbTe based quantum wells (QW?s) has have been widely used to fabricate infrared (IR) lasers, IR detectors and thermogenerators [1]. Also, due to the large interest in spintronic devices developments, some efforts have been actually dispended to the investigation of spin-orbit (SO) coupling and quantum Hall effect in different nanostructures systems and PbTe based structures have emerged as potential candidates for the development of spintronic devices [2]. We investigated the photoconductivity effect in n-type PbTe/Pb1-xEuxTe quantum wells (QW´s) for temperature range of 300K to 77K using infrared light. The measurements revealed that at high temperatures the photoresponse has small amplitude. As temperature decreases it reaches a maximum amplitude around 100K which is 1000 times higher than the original before illumination. Unexpectedly, for further reducing of temperature, the amplitude starts to decrease. This behavior indicates the presence of a transition regime which is a result of parallel transport that occurs between the barriers and the QW even if the barriers are insulators. For temperatures below 100K, the transport is more effective in the QW where the signal decreasing can be associated to the electron-electron scattering due to the increasing of carrier concentration that occurs under illumination. For a further analysis, we performed Hall measurements under dark and light conditions and a general picture of the physical process is presented. We were also able to investigate the persistent photoconductivity effect which is a result of defect states present within the band structure of the QW and barriers. We hope that this investigation leads to the improvement of infrared sensor devices based on PbTe structures.

[1] Pei, Y. L et al, Journal of Alloys and Compounds 514 (2012).
[2] B. Grbic, et al, Phys. Rev. B 77, 125312 (2008).