Transition from negative to positive photoconductivity in *p*-type $Pb_{1-x}Eu_xTe$ films

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The photoconductive properties of *p*-type $Pb_{1-x}Eu_xTe$ epitaxial layers were studied for x values varying from 0.05 up to 0.1 and in the temperature range of 77 – 300K. In literature, it is well-known that a metal-insulator transition occurs around 0.05 at room temperature due to the disorder caused by the introduction of Eu atoms [1]. This work is mainly focused on the study of the insulator regime, i.e., $x>0.05$, with physical description of the photoconductivity effect of *p*-type $Pb_{1-x}Eu_xTe$ films, under infrared (IR) illumination. In this insulator regime, it was observed that the photoconductivity suffers a transition from negative photoconductivity (NPC) to positive photoconductivity (PPC). Our measurements show that the transition from NPC to PPC was observed for temperatures in the range of 170K – 200K. At T ~300K, the photoresponse follows the expected behavior for an insulating sample, where the photoconductivity presents positive amplitude. We will show that the transition from PPC to NPC is related to the 4*f* level, originated from the Eu atoms, that is located inside the band gap for insulating samples [2]. The 4*f* level alters the dynamics of the generation and recombination processes acting as a trapping level leading to the NPC effect. We performed Hall measurements, under illumination and dark conditions, in order to obtain the transport parameters and how they vary under illumination. We also performed x-ray diffraction measurements to verify the morphology of the samples and account for the degree of disorder. Our results present a detailed view of the PPC and NPC effect in these films and we expect that this information can contribute to the development of a new series of infrared optoelectronic sensors based on $Pb_{1-x}Eu_xTe$ compounds.

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References:

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