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Conduction mechanisms in *p*-type Pb_{1-x}Eu_xTe alloys in the insulator regime

Journal of Applied Physics **111**, 123708 (2012); <https://doi.org/10.1063/1.4729813>M. L. Peres^{1, a)}, R. M. Rubinger¹, L. H. Ribeiro¹, C. P. L. Rubinger¹, G. M. Ribeiro², V. A. Chitta³, P. H. O. Rappl⁴, and E. Abramof⁴[View Affiliations](#)[View Contributors](#)

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ABSTRACT

Electrical resistivity measurements were performed on p -type $\text{Pb}_{1-x}\text{Eu}_x\text{Te}$ films with Eu content $x = 4\%$, 5% , 6% , 8% , and 9% . The well-known metal-insulator transition that occurs around 5% at room temperature due to the introduction of Eu is observed, and we used the differential activation energy method to study the conduction mechanisms present in these samples. In the insulator regime ($x > 6\%$), we found that band conduction is the dominating conduction mechanism for high temperatures with carriers excitation between the valence band and the $4f$ levels originated from the Eu atoms. We also verified that mix conduction dominates the low temperatures region. Samples with $x = 4\%$ and 5% present a temperature dependent metal insulator transition and we found that this dependence can be related to the relation between the thermal energy $k_B T$ and the activation energy $\Delta\epsilon_a$. The physical description obtained through the activation energy analysis gives a new insight about the conduction mechanisms in insulating p -type $\text{Pb}_{1-x}\text{Eu}_x\text{Te}$ films and also shed some light over the influence of the $4f$ levels on the transport process in the insulator region.

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