Weak localization in p-type films of $Pb_{1-x}Eu_xTe$

M. L. Peres, V. A. Chitta, Nei F. Oliveira Jr
USP - SP

P. H. O. Rappl, A. Y. Ueta, E. Abramof
INPE

$Pb_{1-x}Eu_xTe$ alloys are IV-VI diluted magnetic semiconductors that has attracted great interest since they can be used as basic materials for detectors and sensors devices. Besides that, the interaction between the free carriers spin with the Eu^{2+} localized magnetic moments can significantly modify the electrical and optical properties of these alloys. The understanding of this interaction is of fundamental importance for the spintronics development. We have investigated the transport properties of p-type $Pb_{1-x}Eu_xTe$ layers as a function of Eu content x varying from 0% to 10%. It is known that a metal-insulator transition occurs for $x\sim$10% for n-type samples [Phys. Rev. B 59, 12983 (1999)] and for $x\sim$5% in p-type [Journal of Superconductivity 16, 1, 115 (2003)]. The metal-insulator transition is caused by disorder due to the introduction of the Eu^{2+} ions in the alloy and apparently this disorder is stronger in p-type samples. Magneto-transport measurements were performed in both types of samples. Positive and negative contributions to the magnetoresistance were observed. The positive contribution is classically expected while the negative contribution originates from the quantum interference known as Weak Localization and is also a disorder consequence. To investigate the evolution of the localization effect with x, samples were electrically characterized using Hall effect measurements for temperatures varying from 300K down to 10K. The magnetoresistance has been measured for temperatures in the range of 100K down to 1.3K while the magnetic field varies from 0 up to 7T. The evolution of the negative magnetoresistance contribution, at low temperatures, is investigated as a function of the Eu content in the films. The fitting of the magnetoresistance curves in the region of negative values yield us to investigate the scattering times and the spin relaxation mechanisms present in the p-type $Pb_{1-x}Eu_xTe$ layers, and how their behavior changes with the variation of Eu content.