Influence of the Manganese concentration on carrier transport in III-V diluted magnetic semiconductor

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In the last few years there has been a great interest in III-V Diluted Magnetic Semiconductor (DMS). This happens because III-V (DMS) are very promising for spintronics applications. The spintronics has attracted much attention both theoretically [1-2] and experimentally [3]. The spintronics devices promise to be smaller, more versatile and faster than standard devices. This new breed of devices is based on the effect called Giant Magnetoresistance (GMR), this effect happens when all spins are up or down, creating a large magnetic moment.

The Ga$_{1-x}$Mn$_x$As is one of the most promising materials for spintronics. The Manganese concentration is normally low with $x$ up to 0.078 [4]. In despite of a lot of work dedicated on DMS compounds, few attentions are devoted to the transport process. However, for development of a new class of devices is necessary to have an understanding of the physical process governing this behavior and knowledge the key parameters. Also, is important to know how the Manganese concentration influences the electronic transport.

In this work we investigate theoretically the electronic transport of electrons and holes in Ga$_{1-x}$Mn$_x$As in comparison with GaAs. The focus of our work is the influence of the Manganese concentration on high and low field electron transport in Ga$_{1-x}$Mn$_x$As, using the conventional ensemble Monte Carlo method. The influence of Manganese concentration on the electron transport has been studied in the range of 77K up to 400K. The determination of the characteristics is somewhat uncertain due to a lack of knowledge in the alloy potential. Nevertheless, a study was done to provide some insight about the influence of this parameter on electronic transport of Ga$_{1-x}$Mn$_x$As.