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Charge transport in diluted magnetic semiconductor p-n heterojunctions JINDONG LIU, J. ARCHIBALD PETERS, BRUCE WESSELS, Northwestern University — In recent years, semiconductor spintronic devices have been proposed as promising candidates for memory, sensor, logic, and multifunctional devices. The p-n-p bipolar magnetic junction transistor (MJT) was recently demonstrated using the diluted magnetic semiconductor (DMS) InMnAs as the collector [1]. A current gain βdc as high as 20 of the transistor was observed at 300K. A negative magneto-amplification of -150% is obtained when the applied magnetic field is 8T. In order to assess the theoretical gain for such transistors, we measured the minority carrier lifetime in a p-n InMnAs/InAs heterojunction diode. Using the reverse recovery transient technique, a minority carrier lifetime of 320ns was obtained at room temperature under low-injection conditions. From the measured lifetime and calculated base transport factor, a transistor current gain as high as 5000 is predicted. This is more than two orders of magnitude larger than the gain previously measured for heteroepitaxial InMnAs p-n-p transistors. The large gain should enable realization of highly sensitive magnetic sensors and new spin logic circuits.

[1] N. Rangaraju et al, PRL 105, 117202 (2010)

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