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Magnetic Tunnel Transistors based on GaAs/AlGa As heterostructures

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Metallic magnetoelectronic devices have been studied extensively for last dec ade because of the scientific interest as well as great technological importance. Recently, the scientific activity in spintronics field is extending to the hybrid d evices using ferromagnetic/semiconductor heterostructures and to new ferromagn etic semiconductor materials for future devices. The spin-valve transistor, which was first reported by Monsma[1], is based on spin dependent transport of hot electrons rather than electron near the Fermi energy. Although the spin-valve tr ansistor showed large magneto-current ratio more than 300% and high transit s peed over 10^{-14} sec for 100Å metal base, the low transfer ratio of the order o f 10^{-5} prevents the potential applications[2]. In order to enhance the collector c urrent, we have prepared magnetic tunneling transistor (MTT) with single ferro magnetic base on GaAs/AlGaAs heterostructures collector by magnetron sputteri ng process [Fig. 1]. In addition, we have used GaAs based 2-dimensional elect ron gas to help electrons to transit easily. The fabricated device shows the sup erior schottky barrier with a leakage current of 10^{-9} A on the GaAs/AlGaAs heterostructures at the room temperature. The magneto-current ratios of 3 ~ 4 % were observed at V_{EB} = 1 V range, and high transfer ratios of 10^{-4} at V_{EB}

> 0.6 V were obtained for the magnetic tunnel transistors in the room tempera ture [Fig. 2]. These results suggest a promising candidate for future spintronic applications.

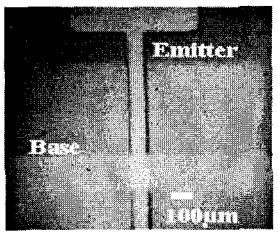

Fig. 1. Micrograph of magnetic tunnel transistor based on GaAs/AlGaAs.

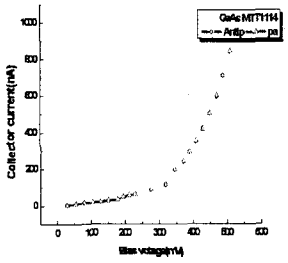

Fig. 2. Magneto- Collector Current at room temperature.

[1] J. S. Moodera, Lisa R. Kinder, Terrilyn M. Wong, and R. Meservey, Phys. Rev. Lett. **74**, 3273 (1995).

[2] S. van Dijken, X. Jiang, and S. S. P. Parkin, Appl. Phys. Lett. **18**, 3364 (2002).