Fabrication and Characteristics of Magnetic Tunnel Transistors Using the Amorphous n-Type Si Films

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Magnetic tunneling transistor (MTT) device using the amorphous n-type Si semiconductor film for base and collector consisting the [CoFe/NiFe](free layer) and Si(top layer) multilayers is used to study the spin-dependent hot electron magetocurrent (MC) and tunneling magnetoresistance (TMR) at room temperature, respectively. A large MC of more than 40.2% is observed at the emmitter-base bias voltage (V_{EB}) of 0.62 V. The increasing emitter hot current and transfer ratio (I_C/I_E) as V_{EB} are due mainly to a rapid increase of the number of conduction band states in the Si collector. However, above the V_{EB} of 0.62 V, the rapid decrease of MC observed in amorphous Si-based MTT because of hot electron spin-dependent elastic scattering across CoFe/Si interfaces.

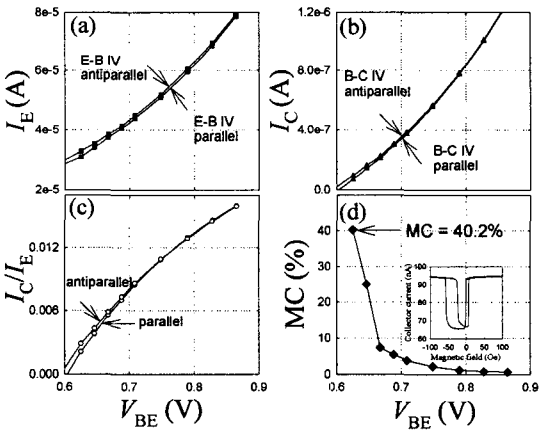

Fig. 1. The emitter-base bias voltage (V_{BE}) dependence of (a) the emitter current (I_E), (b) the collector current (I_C), (c) the transfer ratio (I_C/I_E), and (d) the magnetocurrent (MC). Here the antiparallel and parallel alignments of the emitter and base magnetic moments are distincted. Collector current curve of an MTT as a function the applied magnetic field having a magnetocurrent of 40.2% at room temperature is shown in inset of (d).

References

[1] S. van Dijken, X. Jiang, and S. S. P. Parkin, Appl. Phys. Lett, **80**, 3364 (2002).
[2] D. J. Monsma, R. Vlutters, and J. C. Lodder, Science **281**, 407 (1998).
[3] R. Sato and K. Mizushima, Appl. Phys. Lett. 79, 1157 (2001).