Tunnel Spin Injection from a Ferromagnetic Metal into a Semiconductor Heterostructure

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It is desirable to incorporate ferromagnetic metals into semiconductor spintronic devices because of their high Curie temperatures, low coercive fields, and ready source of spin polarized electrons. The key to efficient spin injection from a metal into a semiconductor heterostructure has recently been shown to be a sufficient interface resistance [1]. Tunnel barriers have been a common way of satisfying this criterion. The natural Schottky barrier at a Fe/AlGaAs interface can serve as an effective tunnel contact if the doping profile of the semiconductor near the interface is engineered to produce a narrow depletion width. In this system, we have successfully injected polarized electrons and obtained electron spin polarizations up to 32% in the GaAs QW [2]. Quantum selection rules directly link the measured circular polarization and the electron spin population. Figure 1 shows the electroluminescence (EL) analyzed for left and right circular polarization of a sample with 32% spin injection efficiency. To determine the transport process, we have analyzed the transport data using the Rowell criteria and determined that single step tunneling is the dominant transport mechanism. A zero-bias anomaly and phonon signatures in the I-V data provide further evidence for tunneling. We also report here recent efforts to characterize transport properties and the physical structure of this interface, and correlate them with the measured spin polarizations.
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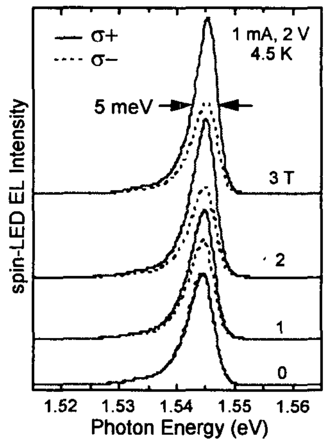

Fig.1. EL spectra of spin-LED analyzed for left and right circular polarization at several applied magnetic fields

References

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