Spin Accumulation Resolved by Coulomb Blockade in a Ferromagnetic Single Electron Transistor

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We report fabrication and measurement of a ferromagnetic single electron transistor. Clear magneto resistance plateaus indicate well controlled states of parallel- and antiparallel-magnetization. A distinct shift in the Coulomb blockade diamond in gate charge between these two states suggests that the island chemical potential for spin-up and spin-down electrons are separated. This shift is attributed to the enhanced spin accumulation arising from Coulomb blockade of spin tunneling in anti parallel magnetization state. The proposed model is confirmed by numerical Monte Carlo calculation.

**Fabrication of Ferromagnetic Single electron transistor**

![Fabrication of Ferromagnetic Single electron transistor](image)

**Figure 1:** Device fabricated using shadow evaporation method, with Py island of size approximately 180nm x 40nm

**Well controlled states of Parallel- & Anti parallel-**

![Well controlled states of Parallel- & Anti parallel-](image)

**Figure 2:** Tunneling magneto resistivity (TMR) observed at 8.68mV of source-drain bias voltage ($V_b$), showing a sharp anti parallel switching at approximately 2000Oe and parallel switching near 6000Oe. At each stable plateau marked in alphabetical order, conductance($G$) as function of $V_b$ and gate voltage, $V_g$ was measured and shown here in four corners respectively. (to be cont.)

![Figure 2 (cont.)](image)

**Figure 2 (cont.):** Inset of each stability diagram illustrates the possible relative magnetic domains’ orientation in the vicinity around Py island, which best explains the evolution of ‘polarization’ of Coulomb diamond apex. It’s also consistent with the shift of Coulomb diamond gate dependence, which is shown between each upper and lower stability diagrams.