Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics

SUPPORTING INFORMATION

Device for Measuring Spin Selectivity in Electron Transfer

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Device fabrication and characterization:

The devices (Fig.S1; Ni/AlOx/Ag) were prepared by photolithography followed by e-beam evaporation on silicon (<100>, 400Ω per cm^2) substrate. The 1-μm wide 1-mm long, and 150-nm-thick Ni line was evaporated on a 5-nm Ti adhesion layer. The AlOx layer with a thickness of about 0.5nm was deposited by atomic layer deposition (Fiji F200, Cambridge Nanotech.). The top 50-nm-thick perpendicular Ag line was evaporated without any adhesion layer. Gold contacts for wire-bonding are 150 nm thick. A high-resolution scanning electron microscopic (SEM) in-lens-detector image was produced with LEO-Supra-55VP.

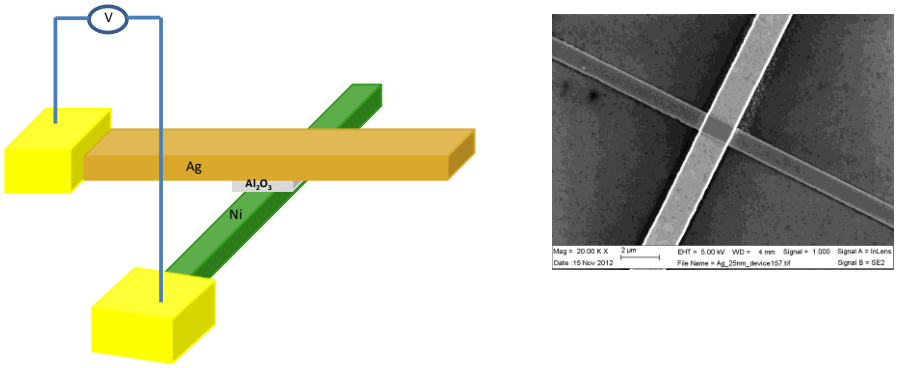

Figure S1: Schematic of the device and its SEM image

The perpendicular magnetization of 150-nm nickel thin film was characterized by Squid with the applied magnetic field being perpendicular to the surface of the sample. The magnetic moment versus the applied field is shown in Fig.S2. The experiments were conducted with a magnetic field of 0.56T applied normal to the Ni surface, and hence the Ni magnetization reached saturation.

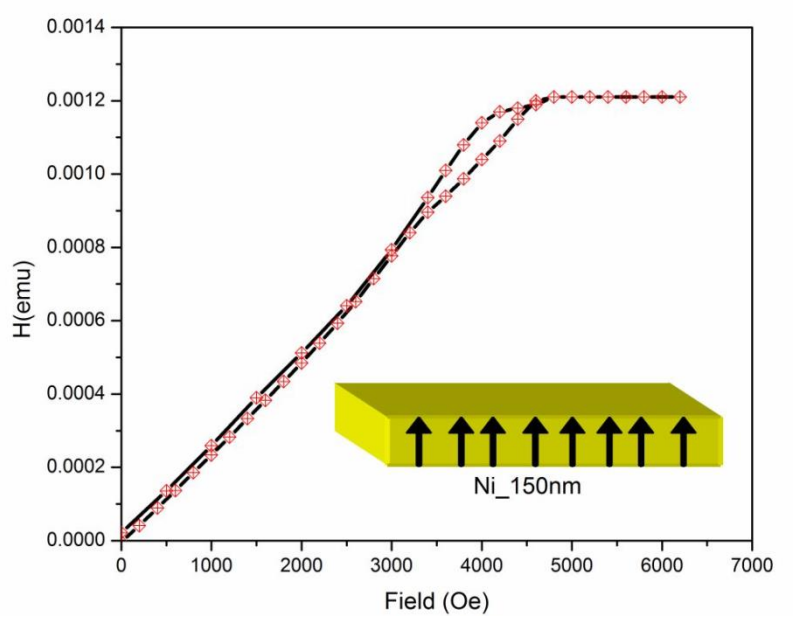

Figure S2: Magnetic hysteresis loop of 150-nm nickel thin film on silicon wafer at 290K

Preparation of self-assembled monolayers of dsDNA

The thiolated single-stranded DNA (HS-ssDNA) is a 30, 40, or 50-base oligonucleotide with the following sequences:

30 bases: 5'-TCT CAA GAA TCG GCA TTA GCT CAA CTG TCA /3ThioMC3-D/-3'

40 bases: 5'-TCT CAA GAA TCG GCA TTA GCT CAA CTG TCA ACT CCT CTT T/3ThioMC3-D/-3'

50 bases: 5'-TAC TCT ACC TTC TCA AGA ATC GGC ATT AGC TCA ACT GTC AAC TCC TCT TT/3ThioMC3-D/-3'

The complementary DNA (comp-DNA) oligomers are the following sequences:

30 bases: 5'-TGA CAG TTG AGC TAA TGC CGA TTC TTG AGA /3Cy3Sp/-3'

40 bases: 5'-AAA GAG GAG TTG ACA GTT GAG CTA ATG CCG ATT CTT GAG A/3Cy3Sp/-3'

50 bases: 5'-AAA GAG GAG TTG ACA GTT GAG CTA ATG CCG ATT CTT GAG AAG GTA GAG TA/3Cy3Sp/-3'

Double-stranded DNA/Cy3 dye was prepared by mixing 10µL of the HS-ssDNA with 11µL of its complementary DNA/Cy3 dye and then kept in a water bath at 90ºC for 10 min and allowed to cool down slowly to room temperature (~3 hrs). From the solution containing the hybridized DNA/Cy3, 20µL was dropped on a device (Ni/AlOx/Ag) pre-cleaned with ethanol. The surfaces with the solution on top of them were kept overnight in a controlled humidity environment, after which the samples were rinsed with 0.4M potassium phosphate buffer and with de-ionized water to remove any excess of DNA and salts and then dried with N_2. Different lengths of dsDNA/Cy3 were prepared the same way. Absorption spectra of DNA with Cy3 dye solution are shown in Fig. S3.

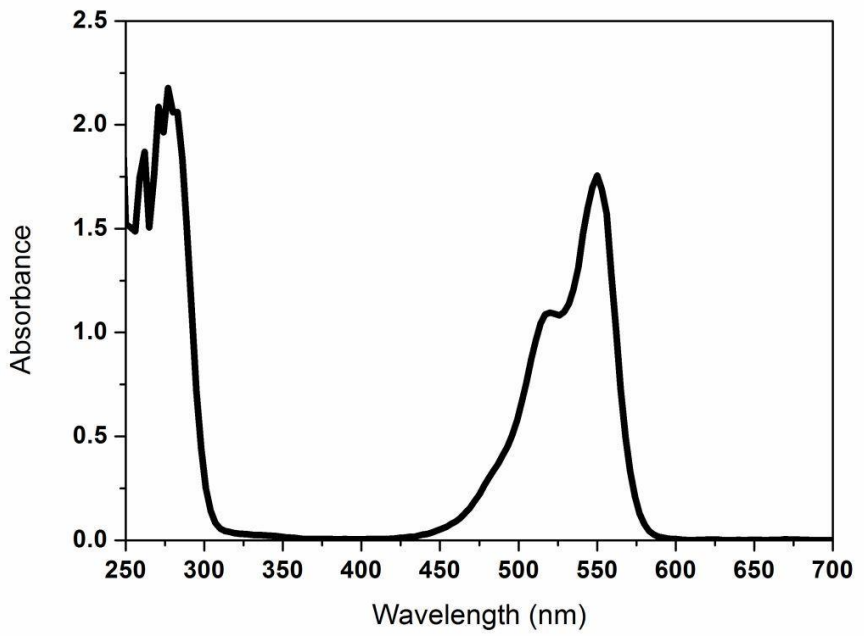

Figure S3: Absorption spectrum of DNA modified with Cy3 dye in buffer solution, pH=7.2

Figure S4 and S5 presents the home-built experimental system.

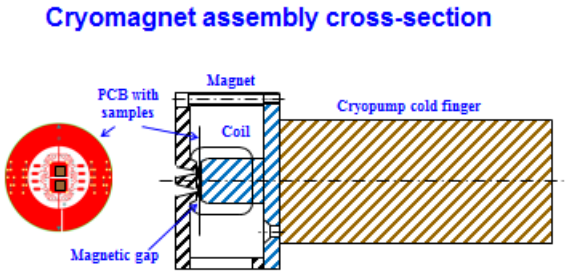

Figure S4: The experimental system. The sample is placed on a PCB (the red circle on the left) and the PCB is put on a sample holder close to the coil of the electromagnet.

Figure S5: The electromagnets. Without conical holes for sample illumination, this magnet having Ø13 mm pole piece and 1.8 mm gap has almost homogeneous field inside the gap along magnet axis. Due to the small conical holes (served for sample illumination) field lines are distorted under the hole, but not strongly. Measurements with Hall probe show that the axial field under the center of the hole drops by about 10-15%. Due to axial symmetry near the center of hole (also the sample center) the field has almost only axial component without radial (tangential) component.
This magnet enables to work with fields up to 0.45-0.5 Tesla.