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Magnetotransport study in Co-Al-Co single-electron transistors

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We have investigated the biased-voltage dependent oscillation behavior of magnetoresistance in Co-Al-Co single-electron transistors (FSF-SETs). The samples were fabricated by using electron-beam lithography and three-angle shadow evaporation techniques. A native Al_2O_3 covers up the Al island to be a tunneling barrier and two Co electrodes are piled up on the both ends of it to be the spin-injector and spin-detector. The electric capacitances of two tunneling junctions are small, the discrete charging energy of the Al island leads to a characteristic Coulomb staircase at higher voltages. Magnetic force microscopy (MFM) was used to clarify magnetization states of two Co electrodes and scanning electron microscopy (SEM) was used to observe morphology of samples. Although the dimensions of two magnetic leads are almost the same, the MFM images show two magnetization states, parallel and antiparallel states, for reversibly switching magnetic fields. We measured our samples by using a dilution refrigerator at 200 mK and applied magnetic fields along the current direction up to 2.5 T. Conductance G is determined by dI/dV and magnetoresistance MR is determined by Gp/Gap - 1. Conductance-voltage characteristics show an oscillation behavior with increasing biased-voltage, which is coming from the Coulomb staircase. And the value of MR varies with increasing biased voltage from positive to negative periodically is also resulting in Coulomb staircase structure.

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Magneto-Transport Studies of Single Ferromagnetic Nanowire

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Spintronics is the study of electron spin in solid state devices and potential devices that exploit spin properties instead of or in addition to the charge degree of freedom. As the fundamental limitation in electron charge based devices is approaching, electron spin provides another degree of freedom, which can be manipulated to give new functionality for next generation devices.

To progress forward in spintronics, a good understanding of several key concepts is needed. One of the more important issues is spin-polarized transport across interfaces and how this changes when the dimensions of the structure are reduced to the quantum regime. Related to this issue are the properties of magnetic materials at nanoscale dimensions.

Limited works were reported on the spin-polarized (magneto) transport across nanostructures, which were hindered by difficulties with small sample volumes and connecting to individual nanostructures. In order to bypass these obstacles, most magnetotransport studies were performed on bundles of nanowires embedded in a template or on e-beam lithographically patterned single nanowires. Even though average magnetic properties can be readily obtained from bundled nanowires, this approach cannot provide precise information about the spin transport properties of a single nanowire because of the interference from the dipolar interaction between neighboring nanowires. An e-beam lithographically patterned single nanowire is not restricted by this effect; however the dimensions of these systems was considerably larger, prohibiting an accurate investigation of the magnetic properties at the nanometer scale.

Template-directed electrodeposition of ferromagnetic nanowires (e.g. nickel, cobalt, permalloy, CoNi), followed by magnetic alignment is simple and cost effective method to orient single ferromagnetic nanowire on prefabricated electrodes. In this paper, we demonstrate the manipulation and positioning of a single electrodeposited ferromagnetic nanowire on pre-patterned electrodes. In addition, we report the temperature dependent electro- and magneto-transport properties of nanowire Furthermore, the magnetization reversal process for nanowire was determined.