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Point contact spectroscopy of ferromagnetic/normal metal nano-bridged contact

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1. Introduction

Spin-transfer torque devices, especially giant magneticresistance ratio (GMR) device, are applied in our electronic life. A lot of experimental results such as interfacial microwave oscillation in multilayered ferromagnetic devices and nonvolatile memory devices are reported for their great potential of application. To investigate the spin torque at the interfaces between ferromagnetic film and normal metal, very small size of contact is needed [1,2,3]. We investigated the interfacial electronic transport spectroscopy of single-layed ferromagnetic metal / normal metal (F/N) using very small opening of nano-bridged device.

2. Experimental Methods

We fabricated nano-bridged point contact devices following the standard nano-lithography processes. Fabrication methods and metallic homo-contact spectroscopy such as Cu-Cu or Au-Au are well introduced in the papers of Ref. 5 and 6. Based on the standard Cu-Cu contact, we estimate our nanoholes range from 10nm to 20nm in diameter. In these regime, ballistic transport electrons which are not scattered in the point contact interface dominate so that some of inelastic scattered electrons are detected in the transport spectroscopy. To keep the interface of our nanoholes clean, we in-situ deposited metal films by sputtering on both sides. Contacts were made between the normal metal films (50 nm thick Cu, Au, Al, and Mg) and the ferromagnetic thick film (50 nm thick CoFe, FeNi, Co, Ni).

3. Results and Discussions

Among all combinations of those materials, we observed some excitations only in the contacts of Cu/F (ferromagnetic metal) when we applied zero magnetic field at liquid helium temperature. These excitations were found to depend on the direction of the electron's flow; it is present only when the electrons flow from Cu to F. So we think that these are related to the relatively long spin diffusion length in Cu. In Cu, the accumulated spins at the interface give an additional spin torque to the interfacial ferromagnet, which results in the local spin precession of the ferromagnet [1,3,4]. And including some spin scatterer such as Au in the Al/CoFe interfaces, excitation was found. We present and discuss our single-layered F/N contact spectroscopies.

4. References

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