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Spin injection and accumulation in FM/NM/FM lateral spin valves

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Spin injection has been of great importance for spintroincs in which electron spin is a subject to manipulate to create new functionality of electronic devices. Efficient electrical injection of spin-polarized carriers as well as long spin diffusion length of a channel are important factors to realize spin field effect transistor (FET).[1,2] A lot of works have focused on spin injection into semiconductors,[3~5] but the results to date are not quite satisfactory because of the intrinsic conductivity mismatch between ferromagnetic metal and semiconductors.[6] On the other hand, spin injection into nonmagnetic metal has been actively studied in the nano-scale spin valve devices, [7~10] and successful spin injection has been achieved because there is no severe conductivity mismatch between ferromagnetic and nonmagnetic metals.

The electrical injection and accumulation of spin current from ferromagnetic permalloy (FM) into nonmagnetic metal (NM) were investigated using nano-scale lateral FM/NM/FM spin valve devices. Clear spin valve effects were found in both local spin valve (LSV) and non-local spin valve (NLSV) measurements from 15K to room temperature. The spin valve signal depends on the magnitude of the bias current, measured temperature and the separation between two ferromagnetic electrodes. Based on the NLSV measurement, the spin diffusion length of Au was estimated to be 85nm and high spin injection efficiency of 67 % at 15 K was achieved from our devices.

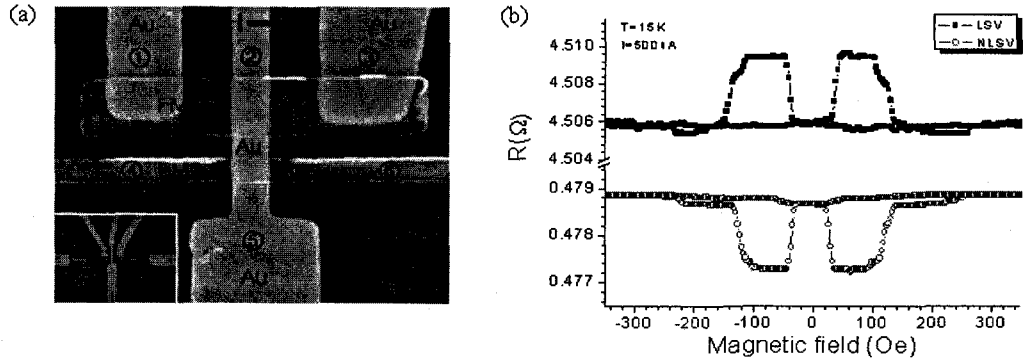

Fig. 1. (a) SEM image of the spin-valve device fabricated in the study, (b) The local (top) and non-local (down) spin valve effect of the device with a FM spacing of 200 nm measured at 15K.