P-7

Spin Injection from a Ferromagnetic metal into a Semimetal

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We present the spin transport in a spin-injection device, consisting of Bi thin film and two ferromagnetic contacts: a spin injector ($Ni_{81}Fe_{19}$) and a detector ($Co_{84}Fe_{16}$). Due to the long carrier mean free path *l*, the Bi thin film is expected to be a good spin channel for demonstrating spin injection. A spin-injection device based on the Bi films has been fabricated using photolithography process. The channel length between two ferromagnetic electrodes was varied from 1 um to few tens of micron in order to estimate the spin relaxation length in Bi thin film. The devices were annealed at the temperature just below melting point of bismuth to enhance the quality of Bi crystal structure, related to mean free path in the Bi thin film. The spin transport in the device was investigated at 2K by "spin-valve" and "non-local" measurements. The non-local output voltage is found to depend upon the relative magnetization state of the two FM electrodes, indicating that the spin-polarized electrons are injected from the first FM (injector) into Bi and are detected by the second FM (detector) due to spin accumulation. The observed Hanle signal in our device suggests that injected spins can be controlled by coherent spin precession caused by an external magnetic field. Our results demonstrate that spin-polarized electrons are injected from an FM injector into Bi and are detected by an FM detector in an FM/Bi/FM spin-valve device.