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Determination of spin diffusion length of gold utilizing lateral spin valves[1] YI JI, AXEL HOFFMANN, SAM JIANG, SAM BADER, Materials Science Division and Center for Nanoscale Materials, Argonne National Laboratory
— Spin transport in lateral metallic structures is an intriguing, emerging area, which offers rich opportunities to explore complex spintronic devices. We demonstrate spin injection, diffusion, and detection in a series of lateral spin valves. A 220-nm wide and 20-nm thick gold wire is defined by e-beam lithography on a SiN substrate. Two permalloy (Py) electrodes, an injector and a detector, are subsequently overlaid on the Au wire. The charge current and spin current are separated by connecting current drain and voltage ground to opposite ends of the Au wire. A charge current that passes through the Py injector into the Au induces a spin accumulation, resulting in a split of the chemical potentials for the spin-up and spin-down electrons in the Au. The injected spins diffuse away on both sides of the injector, resulting in a spin current towards the detector even without a charge current. Depending on the relative orientations of the accumulated spin and the detector spin, a voltage contrast can be observed at the detector/Au interface. This separation of charge and spin currents results in a large percentage value of the spin signals, which rules out the possibilities of spurious effects such as AMR. By changing the injector-detector separation, we observe an exponential decay of the spin signals, and thus determine a spin diffusion length of 63 nm in Au at 10 K.

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