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TITLE: Pure Spin Currents in Lateral Spin-Valves

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ABSTRACT BODY: Most spin-transport measurements have been performed in quasi-one-dimensional structures, where charge and spin transport is by default parallel. Recently there has been increased interest in investigating two-dimensional spin-transport structures, where charge and spin currents can be separated. This enables a direct determination of fundamental parameters for spin-transport, such as spin diffusion lengths and the polarization of injected currents. In this work, we demonstrate non-local spin injection and detection in lateral spin-valves based on permalloy (Py)/Au/Py [1,2] and Co/Cu/Co [2,3] structures. The lateral spin-valves consist of a normal metal (Au or Cu) wire connected to two ferromagnetic contacts (Py or Co). The measurement geometry is such that the charge current is drained at one end of the wire, while the spin diffusion is detected toward the opposite end. In this way a pure spin accumulation without a charge current is measured at the detection contact, which results in a large voltage contrast upon switching the magnetization of either the injector or detector. Changing the injector and detector separation permits a direct determination of the spin diffusion length. Using this technique we determined the spin diffusion length at 10 K to be 63±15 nm for Au [1,2] and 200±20 nm for Cu [2,3]. Furthermore, the injected current polarization was 3% for Au and 7% for Cu. We attribute the improvement of the injection polarization for the Co/Cu/Co lateral spin-valves to higher interfacial quality obtained by fabricating the device with oblique-angle deposition [3]. We also measured the spin-accumulation in Co/Cu/Co devices at room temperature and obtained a lower bound of the spin-diffusion length in Cu of 110 nm. —- This work was supported by U.S. DOE Office of Basic Energy Science – Materials Science under Contract No. DE-AC02-06CH11357 and DE-AC02-05-CH11231.

References: [1] Y. Ji, A. Hoffmann, J. S. Jiang, and S. D. Bader, Appl. Phys. Lett. 85, 6218 (2004).
[2] Y. Ji, A. Hoffmann, J. S. Jiang, J. E. Pearson, and S. D. Bader, J. Phys. D: Appl. Phys. 40, 1280 (2007).
[3] Y. Ji, A. Hoffmann, J. E. Pearson, and S. D. Bader, Appl. Phys. Lett. 88, 052509 (2006).