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Anisotropic spin-relaxation in mesoscopic copper wires FATIH KANDAZ, Department of Physics and Astronomy, University of Delaware, CHAO ZHOU, Department of Physics, Fudan University, YUNJIAO CAI, CHUAN QIN, Department of Physics and Astronomy, University of Delaware, MENGWEN JIA, Department of Physics, Fudan University, ZHE YUAN, Department of Physics, Beijing Normal University, YIZHENG WU, Department of Physics, Fudan University, YI JI, Department of Physics and Astronomy, University of Delaware — Spin-orbital (SO) effects play important roles in spintronics. The SO effects not only generate spin currents and spin torques, but also provide ways to modulate and control spin currents. However, SO effects induce higher rates of spin relaxation and therefore lead to shorter spin-relaxation length in materials, which is incompatible with the general desire for a longer spin-relaxation length to transport a spin current over distance. We demonstrate that substantial SO effects and a long spin diffusion length can coexist in a mesoscopic Cu channel. Anisotropic spin signals are observed in nonlocal spin valves. The spin signals are higher when the spins are aligned parallel to the Cu channel and lower when aligned perpendicular to it. The percentage of the anisotropic change increases with Cu channel length between the spin injector and detector, indicating that the Cu spin-relaxation length is anisotropic. The anisotropic differences of spin-relaxation lengths, estimated from two sets of samples, are 5% and 9%. The experiments can be explained by Rashba effects on the surfaces of Cu channels. The spin-flip probabilities of surface scatterings are larger for spins perpendicular to the surface than for spins parallel to it.

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