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Imaging Stationary Flow of Spin Hall Effect-Induced Spin Densities in Mesoscopic Nanostructures LIVIU ZÂRBO, University of Delaware, SATOFUMI SOUMA, Tokyo University of Science, BRANISLAV NIKOLIĆ, University of Delaware — The spin Hall effect has recently attracted a lot of attention in semiconductor spintronics since it offers a novel way of all-electrical generation and manipulation of pure spin currents by employing spin-orbit (SO) couplings. To describe spin Hall transport on a scale of a few nanometers we introduce the concept of bond spin current and corresponding local flowing spin densities between the sites of the lattice model of a multiterminal SO coupled semiconductor nanostructure, and express them in terms of the nonequilibrium (Keldysh) Green functions. Our predictions for the out-of-plane polarized steady state spin densities flowing into the transverse interaction-free electrodes due to the longitudinal charge current injected into high-mobility two-dimensional electron gas (2DEG) with Rashba SO coupling crucially depend on the size of 2DEG in the units of spin precession length. In the presence of disorder, the flowing spin Hall densities remain non-zero in the bulk of the 2DEG. Moreover, we also find in-plane polarized spin densities flowing into the longitudinal leads due to the magneto-electric effect. These theoretically predicted images of mesoscopic spin Hall flow could be tested via recently advanced Kerr rotation microscopy.

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