MAR15-2014-008879

Abstract for an Invited Paper
for the MAR15 Meeting of
the American Physical Society

Current-induced spin polarization in anisotropic spin-orbit fields[1]

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Current-induced spin polarization is a phenomenon in which carrier spins are oriented when subjected to current flow[2]. However, the mechanism that produces this spin polarization remains an open question. Existing theory predicts that the spin polarization should be proportional to the spin-orbit splitting yet no clear trend has been observed experimentally. We perform experiments on semiconductor samples designed so that the magnitude and direction of the in-plane current and applied magnetic field can be varied and measure the electrical spin generation efficiency and spin-orbit splitting using optical techniques[3]. Contrary to expectation, the magnitude of the current-induced spin polarization is shown to be larger for momentum directions corresponding to smaller spin-orbit splitting. In addition, angle-dependent measurements demonstrate that the steady-state in-plane spin polarization is not along the direction of the spin-orbit field, which we attribute to anisotropic spin relaxation. Furthermore, we show that this electrically-generated electron spin polarization can produce a nuclear spin hyperpolarization through dynamic nuclear polarization[4].

[1]This work is supported by AFOSR, DTRA, NSF, and ONR, and conducted in collaboration with B. M. Norman, C. J. Trowbridge, M. Luengo-Kovac, Y. K. Kato, D. D. Awschalom, S. Huang, and R. S. Goldman.

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