MAR06-2005-001936

Abstract for an Invited Paper
for the MAR06 Meeting of
the American Physical Society

Enhancement of Spin Coherence Using Q-factor Engineering in Semiconductor Microdisk Lasers[1]

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Semiconductor microcavities offer unique means of controlling light-matter interactions in confined geometries, resulting in a wide range of applications in optical communications and inspiring proposals for quantum information processing and computational schemes. Studies of spin dynamics in microcavities have revealed novel effects such as polarization beats, stimulated spin scattering, and giant Faraday rotation. Here, we study the electron spin dynamics in optically-pumped GaAs microdisk lasers with quantum wells (QWs) and interface-fluctuation quantum dots (QDs) in the active region. Using all-optical time-resolved measurement techniques, we examine how the electron spin dynamics are modified by the stimulated emission in the disks, and observe a surprising enhancement of the spin coherence time when the optical excitation is in resonance with a high quality ($Q \sim 5000$) lasing mode[3]. This resonant enhancement, contrary to expectations from the observed trend in the carrier recombination time, is then manipulated by altering the cavity design and dimensions. In analogy to devices based on excitonic coherence, this ability to engineer coherent interactions between electron spins and photons may provide novel pathways towards spin dependent quantum optoelectronics.

[1]This work was supported by DARPA/QUIST and NSF

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[3]S. Ghosh, W. H. Wang, F. M. Mendoza, R. C. Myers, X. Li, N. Samarth, A. C. Gossard, and D. D. Awschalom, *Nature Materials*, accepted for publication (2005). (cond-mat/0509500).