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Spin coherence of electrons in singly-charged quantum dots

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We present experimental and theoretical study on electron spin coherence in ensemble of n-type doped InGaAs/GaAs quantum dots containing one electron per dot. A pump-probe time-resolved Faraday rotation technique is exploited. Long-lived spin precession of resident electrons in external magnetic fields is observed with the dephasing time of spin ensemble exceeding 6 ns. Rabi oscillations of the Faraday rotation amplitude has been detected confirming the suggested model of generation electron coherent via excitation of coherent superposition of the trion state and the resident electron [1]. We show that the ensemble dephasing can be overcome by using a periodic train of light pulses to synchronize the phases of the precessing spins. This mode-locking leads to constructive interference of contributions to Faraday rotation, and presents potential applications based on robust quantum coherency within an ensemble of dots [2, 3]. Under these experimental conditions spins of the dots nuclei are aligned in a way that all dots in the ensemble contribute to the coherent signal with a potential to focus the electron Larmor frequencies in the ensemble to a single mode [4]. The used optical technique allows to recover the coherence time of a single quantum dot. The measured spin coherence time is 3 microseconds, which is four orders of magnitude longer than the ensemble dephasing time of 400 picoseconds. This work is done in collaboration with A. Greilich, I. A. Yugova, R. Oulton, M. Bayer, A. Shabaev, Al. L. Efros, D. Reuter and A. D. Wieck.

[1] A. Greilich, et al., Phys. Rev. Lett. 96, 227401 (2006).
[2] A. Greilich, et al., Science 313, 331 (2006).
[3] A. Greilich, et al., Phys. Rev. B 75, 233301 (2007).
[4] A. Greilich, et al., Science 317, 1896 (2007).