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Electron Spin Decoherence via Optical Phonons in Quantum Dots[1] YURIY SEMENOV, KI WOOK KIM, North Carolina State University —

Electron spin decoherence caused by elastic spin-phonon processes is investigated comprehensively in a zero-dimensional environment. Specifically, a theoretical treatment is developed for the processes associated with the anharmonic vibrations of optical phonons in the semiconductor quantum dots. The optical phonons possess relatively high energy that was reasons not involving them to the problem of quantum computing decoherence to present day. This is true if we associate spin decoherence with inelastic processes of spin relaxation that needs thermal activation of optical phonons. In the case of elastic processes the uncontrolled variation of spin phase can happen without presence of thermal phonons. Zero-point optical vibrations, which survive at low enough temperatures can contribute to spin decoherence. Advantage of the optical modes is conditioned by their relatively high contributions at small phonon wave vectors as well as sufficiently short optical phonon lifetime. Calculations of decoherence time T_2 under the g-factor optical phonon modulation predict relatively weak dependence on a magnetic field, $\sim B^{-2}$, that leads to estimation $T_2 \sim 10^{-5}$ s in III-V semiconductor quantum dot at B=1 T.

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