Resistively Detected ESR and ENDOR Experiments in Narrow and Wide Quantum Wells: A Comparative Study

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Abstract. Resistively detected electron-spin resonance and electron nuclear double resonance spectra have been acquired in the lowest electronic subband of a remotely Si-doped 400-nm wide GaAs/AlAs digital parabolic quantum well in high parallel and perpendicular magnetic fields at temperatures in the 0.5–10 K range. The temperature dependences of the g-factor, ESR linewidth, line amplitude and nuclear-spin relaxation times, acquired in the two different orientations, are compared to data obtained previously in a 30-nm GaAs quantum well with similar electron density and mobility.

1 Introduction

In a parabolic quantum well (PQW) formed by an AlAs/GaAs digital superlattice, the aluminum fraction in the center of the well is zero but increases along the growth direction toward each barrier, yielding a parabolic conduction electron potential $V(z) = (az)^2$. Such quantum structures have several interesting properties that might prove advantageous for spin-based devices. For example, it has been shown that the electron density in the PQW can be shifted substantially at relatively modest gate voltage [1]. Because the Landé g-factors in GaAs and AlAs are -0.44 and 1.99, respectively [2, 3], the g-factor in the electron system is gate controllable over a wide range [1]. The g-factor is also tunable by varying the electron density, temperature, or well-width [4, 5]. Furthermore, g is expected to depend on the angle θ between the growth direction (z) and applied magnetic field (B). A $\theta = 0° \rightarrow 90°$ rotation in a sufficiently strong magnetic field causes the two-dimensional electron system (2DES) of the wide PQW to evolve into a quasi-3DES.

Here, we employ resistively detected ESR (RDESR) and electron nuclear double resonance (RDENDOR) to study a remotely Si-doped 400-nm wide GaAs/AlAs digital PQW in high parallel ($\theta = 90°$) and perpendicular ($\theta = 0°$) fields. The temperature dependences of the g-factor, linewidth

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