Optically-Detected Electron Spin Resonance of Self-Assembled InAs Quantum Dots

JOHN S. COLTON, AARON MITCHELL JONES, STEVE BROWN, SCOTT THALMAN, DALLAS SMITH, Brigham Young University, AL-LAN BRACKER, Naval Research Laboratory — Optically-detected magnetic resonance (ODMR) of electron spins has been performed on self-assembled InAs quantum dots. A cw probe laser was used to monitor the Kerr rotation of a subset of the dots (those resonant with the laser) as microwaves induce transitions between spin states, separated by \( \sim 12 \) GHz at \( \sim 1.8 \) T. At high powers (optical and microwave), the ODMR response seems to be a jumble of peaks superimposed on each other. At low powers, however, individual peaks can be resolved. And, at the lowest power a single ODMR peak is evident. The \( g \)-factor and \( T_2^* \) value obtained from the lowest power ODMR peak position and width were \( |g| = 0.485 \) and \( T_2^* = 3 \) ns. This lifetime is consistent with hyperfine effects rather than inter-dot inhomogeneity being the limiting factor. By way of comparison, measurements from time-resolved Kerr rotation indicated a \( T_2^* \) of 1 ns at small fields, which decreased to less than 0.5 ns at 2 T due to inhomogeneities in the \( g \)-factor. Both of these observations are consistent with the hypothesis that at the lowest powers, we are seeing a response from a very small number of homogeneous quantum dots, possibly even an individual quantum dot.

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