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Influence of CoFe nanopillars on spin coherence in an InGaAs quantum well YAO ZHANG, J.J. HEREMANS, Virginia Tech — An array of ferromagnetic ($Co_{0.6}Fe_{0.4}$) nanopillars was fabricated on the surface of an InGaAs/InAlAs heterostructure. The interactions between the magnetic moments of the nanopillars and two-dimensional electrons in the $In_{0.53}Ga_{0.47}As$ quantum well are experimentally studied by low-temperature antilocalization measurements. The presence of ferromagnetic nanopillars increases the spin-orbit scattering rate, interpreted as due to the spatially varying nanopillar magnetic field. At the quantum well, also an appreciable average fringing field ~ 35 G normal to the surface is generated by the large saturation magnetization of the nanopillars. Numerical values show a good correspondence between the analysis of the experimental antilocalization data and calculations from a simple micromagnetic model. The measurements further show an increase in mobility due to surface metal coverage. Consistently, non-magnetic coverage is observed to decrease the spin-orbit scattering rate, as expected for increased Coulombic screening under the Elliott-Yafet spin-decoherence mechanism. The analysis also shows the inelastic scattering rate increasing as temperature increases, consistent with the Nyquist mechanism. The work is supported by DOE DE-FG02-08ER46532.

Yao Zhang
Virginia Tech

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