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Spin-Orbit Coupling in AlGaN/AlN/GaN Heterostructures with a Polarization Induced Two-Dimensional Electron Gas H. CHENG, C. KURDAK, Physics Dept, Univ of Michigan, N. BIYIKLI, U. OZGUR, H. MORKOC, Dept of Electrical Engineering, Virginia Commonwealth University, V.I. LITVINOV, WaveBand/Sierra Nevada Corporation,Irvine,CA,92618 — Spin-orbit coupling is investigated by weak antilocalization and Shubnikov-de Haas measurements in wurtzite $Al_xGa_{1-x}N$/AlN/GaN heterostructures with a polarization induced two dimensional electron gas. By employing the persistent photoconductivity effect and by using five different heterostructures with different Al compositions, we cover a carrier density range extending from 0.8×10^{12} cm^{-2} to 10.6×10^{12} cm^{-2}. We determine electron splitting energies for different carrier densities by analyzing the weak antilocalization measurements using the Iordanskii, Lyanda-Geller, and Pikus theory. We find the spin splitting energies do not scale linearly with the Fermi wavevector k_F at high carrier densities. By fitting the spin splitting energies to a form E_{SS}=$2(\alpha k_F + \gamma k_F^3)$ we extract linear and cubic spin-orbit coupling parameters α=5.13×10^{-13} eV m and γ=1.2×10^{-31}eV m^3, respectively. The cubic spin-orbit coupling parameter is purely due to the bulk inversion asymmetry of the wurtzite crystal and has not been previously measured for the GaN system.

H. Cheng

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