Gate control of InSb quantum wells with ALD gate dielectrics
ALD ゲート絶縁膜による InSb 量子井戸のゲート制御

The successful gate control of InSb two-dimensional systems is essential for extending our RD-NMR studies to the wider-range pump-and-probe experiments. They are also important to spintronics application of InSb systems including Majorana physics. To achieve this goal, high-quality Al_2O_3 dielectrics were grown by atomic layer deposition (ALD) on InSb quantum wells. Magnetotransport measurements were carried out to clarify the characteristics of a gated InSb quantum wells. When we deposited Al_2O_3 dielectrics on InSb top layer, the density of two-dimensional electrons in the QW was tuned by *Vg* but saturated at more negative *Vg*, probably due to hole accumulation at the interface. The better controllability without parallel conduction appears when we deposited Al_2O_3 dielectrics directly on InAlSb top layer. The wider bandgap of $Al_{0.1}In_{0.9}Sb$ top layer resulted in a linear, sharp, and non-hysteretic response of the 2DEG density to the gate bias as shown in Fig. 1. The obtained gate sensitivity reached to $dn_s/dV_g = 3.9\times10^{15}\ m^{-2}V^{-1}$.

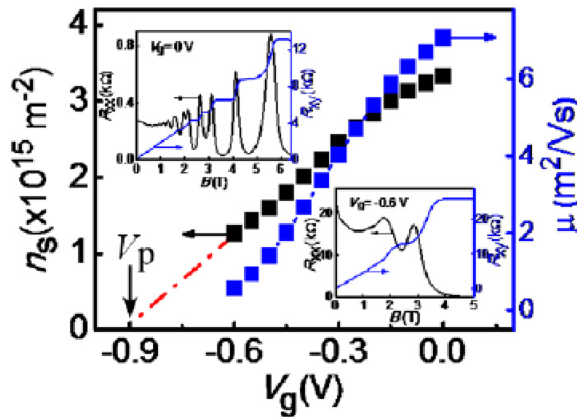

Fig. 1 Electron density n_s and mobility μ of the InSb 2DEG as a function of gate bias V_g for the Al_2O_3–InSb device with the $Al_{0.1}In_{0.9}Sb$ top layer. Insets show the magnetic-field (B) dependent longitudinal resistance R_{xx} and Hall resistance R_{xy} at V_g = 0 V and -0.6 V.

Representative publications:

1. M. M. Uddin, H. W. Liu, K. F. Yang, K. Nagase, T. D. Mishima, M. B. Santos, and Y. Hirayama, Appl. Phys. Lett. 101, 233503 (2012).

2. M. M. Uddin, H. W. Liu, K. F. Yang, K. Nagase, K. Sekine, C. K. Gaspe, T. D. Mishima,4 M. B. Santos, and Y. Hirayama, Appl. Phys. Lett. 103, 123502 (2013).