Gate-Controlled Spin–Orbit Interaction Parameter in a GaSb Two–Dimensional Hole gas Structure

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Gate-controlled spin-orbit interaction parameter is a key factor for developing spin-Field Effect Transistor (Spin-FET) in a quantum well structure because the strength of the spin-orbit interaction parameter decides the spin precession angle [1]. Many researches show the control of spin-orbit interaction parameter in n-type quantum channels, however, for the complementary logic device p-type quantum channel should be also necessary. We have calculated the spin-orbit interaction parameter and the effective mass using the Shubnikov-de Haas (SdH) oscillation measurement in a GaSb two-dimensional hole gas (2DHG) structure as shown in Fig 1. The inset illustrates the device geometry. The spin-orbit interaction parameter of $1.71 \times 10^{11}$ eVm and effective mass of 0.98 $m_0$ are obtained at $T=1.8$ K, respectively. Fig. 2 shows the gate dependence of the spin-orbit interaction parameter and the hole concentration at 1.8 K, which indicates the spin-orbit interaction parameter increases with the carrier concentration in p-type channel. On the order hand, opposite gate dependence was found in n-type channel [1,2]. Therefore, the combined device of p- and n-type channel spin transistor would be a good candidate for the complimentary logic device.

References

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