TT-P066

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

Youn Ho Park[1,2], Hyun Cheol Koo[1,3]*, Sang-Hoon Shin[1], Jin Dong Song[1], Hyung-jun Kim[1], Joonyeon Chang[1], Suk Hee Han[1], Heon-Jin Choi[2]

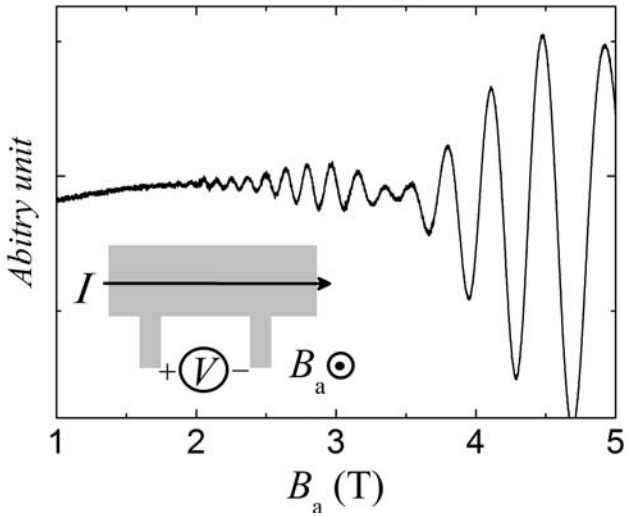
[1]Spin Convergence Research Center, Korea Institute of Science and Technology, Seoul 136-791,
[2]Department of Materials Science and Engineering, Yonsei University, Seoul 120-749,
[3]KU-KIST Graduate School of Converging Science and Technology, Korea University, Seoul 136-701, Korea

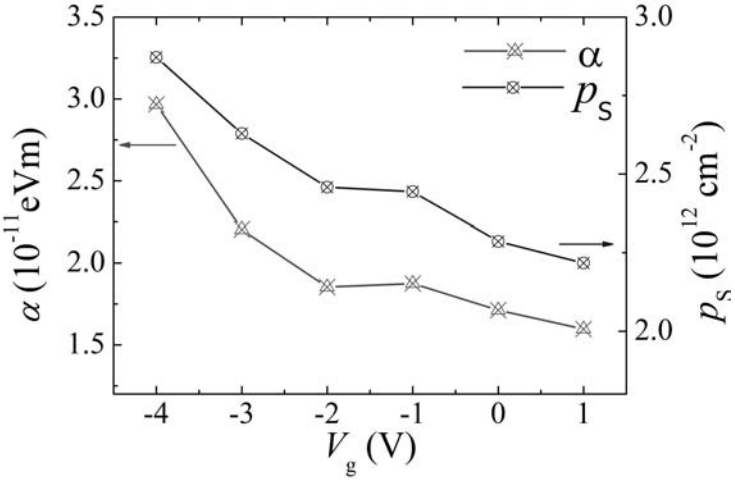
Gate-controlled spin-orbit interaction parameter is a key factor for developing spin-Field Effect Transistor (Spin-FET) in a quantum well structure because the strength of the spin-orbit interaction parameter decides the spin precession angle [1]. Many researches show the control of spin-orbit interaction 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 1.71×10^{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

[1] H. C. Koo, J. H. Kwon, J. Eom, J. Chang, S. H. Han, and M. Johnson, Science, 325, 1515 (2009).
[2] J. Nitta, T. Akazaki, and H. Takayanagi, Phys. Rev. Lett. 78, 1335 (1997).

Keywords: 2DEG, Quantum well, GaSb p-type, Rashba effect, Spin transistor


Abitry unit
I
+V−
B a
1
2
3
4
5
B a (T)


3.5
3.0
2.5
2.0
1.5
α (10-11eVm)
3.0
2.5
2.0
p S (10 12 cm-2)
α
p S
-4
-3
-2
-1
0
1
V g (V)