

課題番号 : F-21-UT-0069
利用形態 : 機器利用
利用課題名(日本語) : InAs/(Ga,Fe)Sb の磁気伝導現象特性評価
Program Title (English) : Evaluation of magnetotransport phenomena in InAs/(Ga,Fe)Sb
利用者名(日本語) : 瀧口耕介、大矢忍、田中雅明
Username (English) : K. Takiguchi, S. Ohya, M. Tanaka
所属名(日本語) : 東京大学工学系研究科電気系工学専攻
Affiliation (English) : EEIS, Graduate School of Engineering, The University of Tokyo
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1. 概要(Summary)

Utilizing a magnetic proximity effect (MPE) in a non-magnetic/ferromagnetic bilayer system is a promising way for introducing ferromagnetism into a high-mobility non-magnetic channel. The MPE in the non-magnetic (NM) semiconductor/ferromagnetic (FM) insulator bilayer is idealistic for large MPE since the MPE can be modulated by using a gate voltage to vary the penetration of the electron wavefunction into the insulating ferromagnetic side. (Fig. 1)

2. 実験(Experimental)

【利用した主な装置】

8 インチ汎用スパッタ装置

高密度汎用スパッタリング装置

【実験方法】

We first patterned the MBE-grown heterostructure samples into $100 \times 400 \mu\text{m}^2$ Hall bars by standard photolithography and Ar ion milling and then formed several electrodes via electron-beam evaporation and lift-off of sputtered Au (50 nm)/Cr (5 nm) films. The depth of milling reached the AlSb buffer layer. To avoid current leakage through the buffer layer, we deposited SiO_2 by the sputtering between the Au pad and the AlSb buffer for passivation.

3. 結果と考察(Results and Discussion)

In this report, we investigate the gate-controlled Shubnikov-de Haas (SdH) oscillation in NM InAs quantum well / FM semiconductor (Ga,Fe)Sb to confirm that the strong MPE is induced in the NM high mobility channel. Thanks to the high

coherency of the NM channel, this is the first study of the Fermiology in a NM/FM bilayer with MPE. According to our SdH analysis, we identify the two Fermi surfaces from spin-split energy bands. Owing to our quantitative analysis of SdH, spin-split energy reaches 6.3 meV in InAs/(Ga,Fe)Sb which is the largest spin splitting via MPE ever reported. Our findings will pave the pathways to establish novel spintronics devices utilizing MPE.

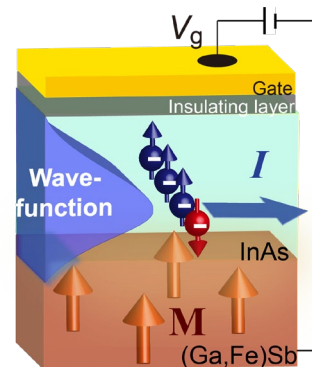


Fig. 1 Schematic image of magnetic proximity effect in InAs/(Ga,Fe)Sb.

4. その他・特記事項(Others) なし

5. 論文・学会発表(Publication/Presentation)

- Harunori Shiratani, Kosuke Takiguchi, Le Duc Anh and Masaaki Tanaka; “Fermiology of InAs/(Ga,Fe)Sb with large gate-controllable magnetic proximity effect”, 強的秩序とその操作に関わる研究会 Online, January 4, 2022. (国内、口頭、査読なし)

6. 関連特許(Patent) なし