

エピタキシャル成長 Fe からの InAs 2 次元系へのスピン注入

Spin injection from epitaxially grown Fe into an InAs quantum well

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Interface condition is a key in the spin injection from ferromagnetic metals into semiconductors. Epitaxial growth of metals directly on semiconductor structures has a natural advantage in getting a clean interface and the combination of Fe and GaAs is most popular for the technique. Here we report spin injection from epitaxially grown Fe into a two-dimensional electron system (2DES) in an InAs quantum well, in which the spin-orbit interaction (SOI) is strong and spin manipulation is available[1].

Figure 1(a) shows a cross sectional view of layered structure. For close contact between the top Fe layer and the 2DES, an inverted doping profile was adopted. The semiconductor part was grown with MBE at ordinary substrate temperatures T_s . Then T_s was lowered to around 0°C for the growth of Fe. As shown in Fig.1(b), the first monolayer deposition of Fe caused significant disorder in the lattice structure but a few successive layer deposition recovers the RHEED intensity and bcc-type crystal structure can be deduced from the bulk spots.

The epitaxially grown Fe layer was fabricated into strip structures shown in the inset of Fig.1(c) (white regions). Figure 1(c) shows non-local (current: Fe-2DES, voltage: the other 2DES-Fe) magnetoresistance for the magnetic field parallel to the strips at 4.2K. There are some fine structures probably due to the formation of multi-domains but clear spin-valve type structure is observable. A coarse estimation of the spin injection gives the injection efficiency of 10%, which is in the same order or even higher than that reported for InAs 2DES with MgO tunnel barriers[2]. Detailed analysis and spin diffusion length experiments will be presented.

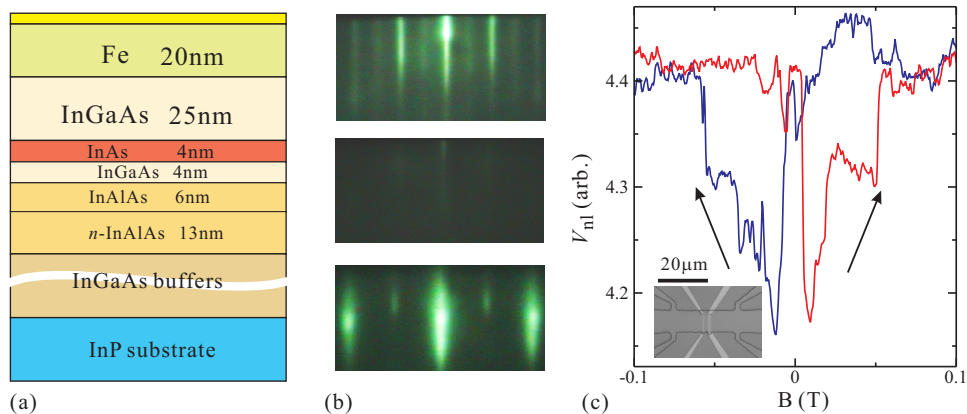


Fig.1 (a) Layered structure of MBE grown sample. (b) RHEED patterns during the MBE growth. Top: (In,Ga)As surface. Middle: First monolayer of Fe. Bottom: 8nm thick Fe layer. (c) Non-local spin-valve magnetoresistance for spin-injection from Fe into I2DES. The inset shows a micrograph of the sample.

References

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- [2] T. Ishikura, Z. Cui, L-K. Liefeth, K. Konishi, K. Yoh, arXiv:1304.1671.