GaAs 基板上に成長させた GaSb バルクのスピン緩和

Observation of spin relaxation in bulk GaSb grown on GaAs substrate

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Gallium antimonide is a III–V semiconductor having a narrow bandgap, a high carrier mobility and a small effective carrier mass. Therefore, GaSb is a suitable material for fabricating high frequency electronic devices.[1] In this study, we have investigated the spin relaxation in GaSb grown on a GaAs substrate by time-resolved pump and probe reflection measurement.

The sample is 1μm-thick GaSb grown on a GaAs substrate by molecular beam epitaxy. The growth temperature is 530 ℃. The spin relaxation process was observed by pump and probe reflection measurement at 10-100 K.[2] A Ti-sapphire laser with an optical parametric oscillator was used as the optical source. The pump beam was chopped by an electro-optic modulator at 1.9 MHz to avoid optical noise in the low-frequency region. The excitation laser wavelengths were tuned to 1509 nm at 10 K, and 1528 nm at 100 K.

The time evolution of spin-dependent reflection intensity for the excitation power of 20 mW at 10 K is shown in Fig.1, where I^+ indicates a right circularly polarized excitation with a right circularly polarized probe, while I^- indicates a right circularly polarized excitation with a left circularly polarized probe. Note that the spin polarization was clearly observed. The time evolution of spin polarization $(I^+ - I^-)/(I^+ + I^-)$ is shown in the inset of Fig.1. The spin relaxation time τ_s, which is twice the relaxation time of the spin polarization, is evaluated to be 158 ps. This spin relaxation time of GaSb is faster than that of GaAs which is measured to be 1.8 ns at 10 K.[3]

Figure 2 shows the excitation power dependence of the spin relaxation time at 10 K. A clear negative excitation power dependence is observed. This result indicates that Bir-Aronov-Pikus process[4] is an effective spin relaxation mechanism at 10 K.

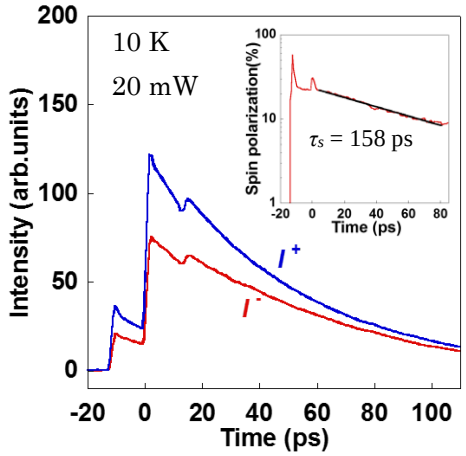

Fig.1 Time evolution of spin-dependent reflection intensity and (inset) spin polarization for the excitation power of 20 mW at 10 K.

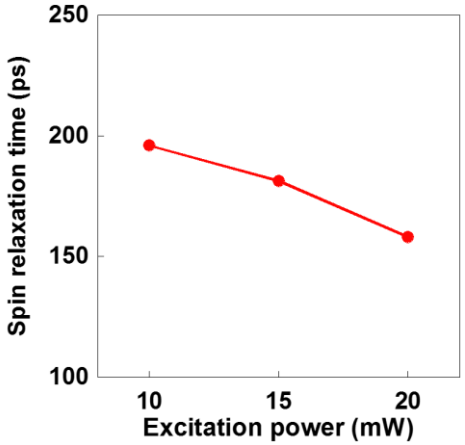

Fig.2 Excitation power dependence of spin relaxation time of bulk GaSb at 10 K.

[1] S. K. Ma et al., J. Phys.: Condens **16**, (2004).
[2] A. Tackeuchi et al., Appl. Phys. Lett. **56**, 2213 (1990).
[3] A. Tackeuchi et al., Appl. Phys. Lett. **84**, 3576 (2004).
[4] G. L. Bir et al, Zh. Eksp. Teor. Fiz. **69**, 1382 (1975); Sov. Phys. JETP **42**, 705 (1976).