GaAs 基板上に成長させた厚さの異なる GaSb バルクのスピン緩和

Spin relaxation in bulk GaSb with different thicknesses grown on GaAs substrates

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GaSb grown on GaAs substrates has been studied extensively in recent years for potential device applications in a variety of mid-infrared lasers and detectors.[1] Due to the 7.8% lattice mismatch between GaSb and GaAs, it is necessary to develop growth methods to reduce strain and the number of dislocations.[2] In this study, we have investigated the spin relaxation in GaSb with different thicknesses grown on GaAs substrates.

Two samples which are GaSb grown on GaAs substrates by molecular beam epitaxy were prepared. The growth temperatures of the two samples are 530°C. The thicknesses of GaSb layers are 5 μm (sample A) and 1 μm (sample B). The spin relaxation process was observed by pump and probe reflection measurement at 10-100 K.[3] An optical parametric oscillator pumped by a Ti-sapphire laser was used as the optical source for the measurement. The time resolution of this measurement system is sub-picosecond.

As for the sample A, the time evolution of spin-dependent reflection intensity at 10 K for an excitation power of 10 mW is shown in Fig. 1, where I^+ and I^- indicate the co-circular and anti-circular polarization, respectively. The time evolution of spin polarization 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 330 ps.

In Elliott-Yafet (EY) process, spin flips by scattering on impurities or phonons.[4, 5] The obtained spin relaxation times for two samples at 10 K for an excitation power of 10 mW are shown in Fig. 2. At 10 K, the spin relaxation time of the sample A is longer than that of sample B. The observed difference in the spin relaxation time indicates that EY process is effective.

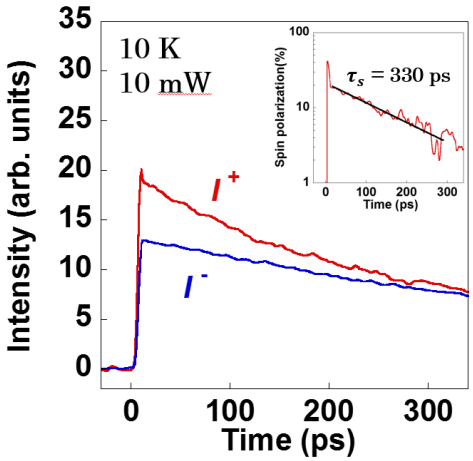

Fig. 1 Time evolutions of spin-dependent reflection intensity and spin polarization (inset) at 10 K for an excitation power of 10 mW (sample A).

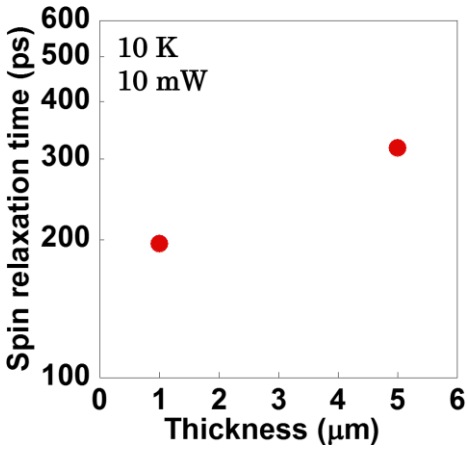

Fig. 2 Spin relaxation times of the sample A (5 μm) and the sample B (1 μm) at 10 K for an excitation power of 10 mW.

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