GaAs 基板上に異なる温度で成長させた GaSb バルクのスピン緩和

Spin relaxation in bulk GaSb grown at different temperatures on GaAs substrate

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GaSb materials grown on GaAs substrates are promising for infrared applications.[1] But a lattice mismatch of ~ 7% exists between GaSb and GaAs.[2] In this study, we have investigated the spin relaxation in GaSb grown on a GaAs substrate at different growth temperatures.

The samples are 1 μm-thick GaSb grown on a GaAs substrate by molecular beam epitaxy. The growth temperatures are 530 ℃ (sample A), 515 ℃ (sample B), 510 ℃ (sample C) and 500 ℃ (sample D). The spin relaxation process was observed by pump and probe reflection measurement at 10-100 K.[3] A Ti-sapphire laser with an optical parametric oscillator was used as the optical source for the pump and probe experiment. The time resolution in this system is sub-picosecond.

As for the sample A, the time evolution of spin-dependent reflection intensity at 10 K for 40 mW is shown in Figure 1, where I^+ and I^- indicate the cocircular and anticircular 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 97.0 ps.

At low temperature, Bir-Aronov-Pikus process[4] is known to be most effective.[5] In Elliott-Yafet (EY) process, spin flips by scattering on impurities or phonons.[6, 7] The obtained spin relaxation times for four samples at 10 K for 40 mW are shown in Fig.2. The spin relaxation time of the sample C is longest in these samples. The observed difference in the spin relaxation times suggests that EY process is also effective.

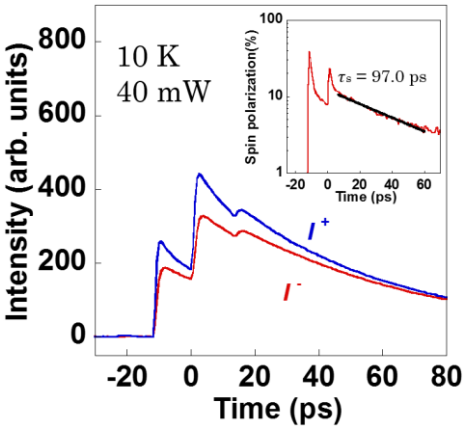

Fig.1 Time evolutions of spin-dependent reflection intensity and (inset) spin polarization at 10 K for 40 mW.

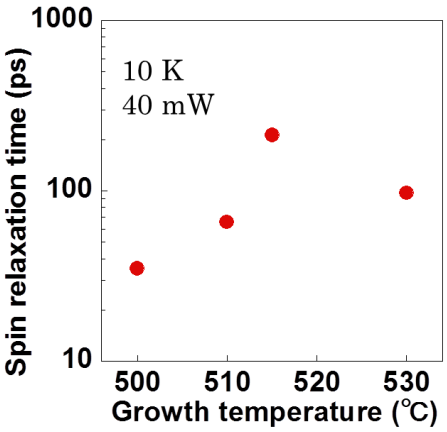

Fig.2 Spin relaxation times of sample A (530℃), sample B (515℃), sample C (510℃) and sample D (500℃) at 10 K for 40 mW.

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