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Be ドープ p 型 GaAs のスピン緩和の観測（10-100 K）

Observation of spin relaxation in Be-doped p-type GaAs (10-100 K)

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The experimental analyses of spin relaxation of p-type semiconductors have attracted considerable attention for the development of theories of spin relaxation mechanisms in semiconductors.[1] Here, we report spin relaxation times in an Be-doped bulk GaAs grown on GaAs substrate at 10-100 K by time-resolved spin-dependent photoluminescence (PL) measurement.

The sample contains a 577-nm-thick GaAs grown on GaAs substrate by Molecular Beam Epitaxy. The Be concentration is 8.1×10^{16} cm^{-3}. The spin relaxation times were measured by time-resolved spin-dependent PL measurement at 10-100 K. In the time-resolved spin-dependent PL measurement, the spin polarized carriers were photoexcited by the circularly polarized femtosecond optical pulses generated from a Ti-sapphire laser. The excitation laser wavelength was tuned to 750 nm. The collected luminescence passes through an analyzer consisting of an achromatic quarter-wave plate and a linear polarizer arranged so that right- or left-circularly polarized emission can be selected. The spin-dependent PL is time-resolved using a streak camera with a time resolution of 15 ps.[2]

Figure 1 shows the time evolution of the spin-dependent PL at 10 K for the excitation power of 7 mW. The blue and red curves indicate the PL intensity of the same (I_+) and opposite (I_-) circular polarizations from the pump laser, respectively. Spin polarization was not observed at higher than 100 K. Figure 2 shows the time evolution of spin polarization at 10 K for the excitation power of 7 mW. The spin relaxation time was obtained to be 0.91 ns using a single exponential fitting. The observed spin relaxation time is close to that of Zn-doped p-type GaAs ($N_A = 2.0 \times 10^{17}$ cm^{-3}) of 1.0 ns.[3]

The presence of carrier density and temperature dependence of the spin relaxation time was observed at 10-50 K. Bir-Aronov-Pikus process[4] and Elliott-Yafet process[5,6] seem to be effective as spin relaxation mechanism.

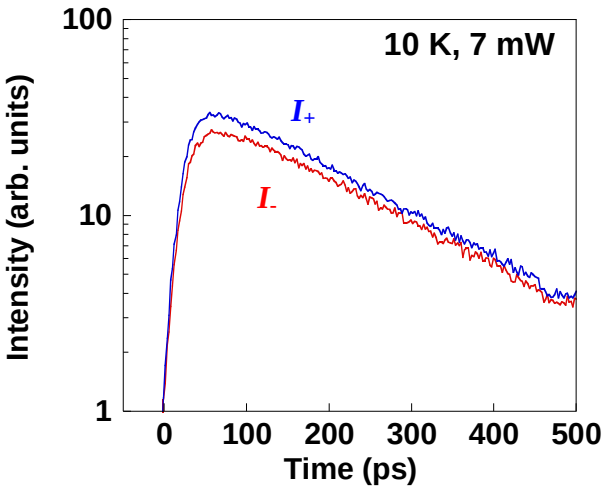

Fig.1 Time evolution of spin-dependent PL intensity at 10 K for the excitation power of 7 mW.

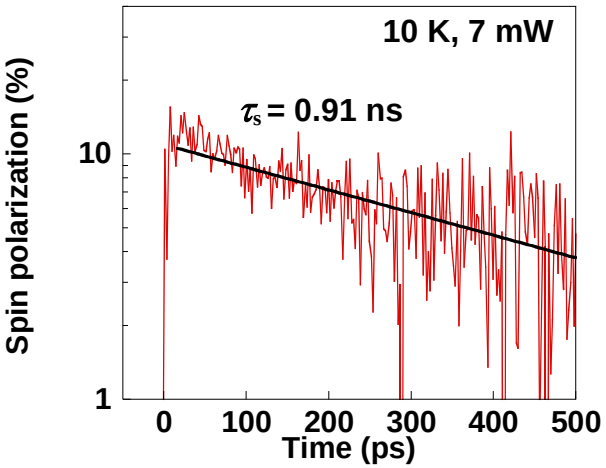

Fig.2 Time evolution of spin polarization at 10 K for the excitation power of 7 mW.

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