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ポンププローブ反射計測による Be ドープ GaAs のスピン緩和の観測

Observation of spin relaxation in Be doped GaAs by pump and probe reflectance measurement

早大理工 [1], SINANO-CAS [2]

○有竹 貴紀 [1], 原澤 遼 [1], 山本 直輝 [1], H. Wu[1], S. L. Lu[2], P. Dai[2], 竹内 淳 [1]

Waseda Univ. [1], SINANO-CAS [2]

○T. Aritake[1], R. Harasawa[1], N. Yamamoto[1], H. Wu[1], S. L. Lu[2], P. Dai[2], and A. Tackeuchi[1]

E-mail: t.aritke@suou.waseda.jp

An electron spin carries information and offers opportunity for a new generation of devices. [1] An understanding of spin relaxation in p-type GaAs is important for future application because p-type GaAs is widely used in electronic and optoelectronic devices. In this study, we report the spin relaxation in Be doped GaAs observed by time-resolved pump and probe reflectance measurement. [2]

The sample is a 577-nm-thick Be-doped GaAs grown on a GaAs substrate by molecular beam epitaxy. The Be concentration is 3.4×10^{17} cm^{-3}. The spin relaxation times were measured by time-resolved spin-dependent pump and probe reflectance measurement. Spin-aligned carriers were generated when electrons were excited by a circularly polarized optical pulse. The photon energy was tuned to observe spin relaxation of excitons bound to neutral Be acceptors. The time resolution of this measurement system was 200 fs, which is determined by the convolution of the optical pulses.

Figure 1 shows the time evolutions of the reflectance of cocircular (I^+) and anticircular (I^-) polarization at 10 K for the carrier density of 9.3×10^{17} cm^{-3} at 810 nm. The inset shows the time evolution of spin polarization: $(I^+ - I^-)/(I^+ + I^-)$. The spin relaxation time τ_s, which is twice the relaxation time of the spin polarization, was obtained to be 276 ps using a single exponential fitting.

Figure 2 shows carrier density dependence of the spin relaxation time of excitons bound to neutral Be acceptors. For lower carrier density, we observed the existence of carrier density dependence of the spin relaxation time by time-resolved spin-dependent photoluminescence (PL) measurement. [3] This dependence indicates that Bir-Aronov-Pikus (BAP) process [4] is effective at 10 K. However, around the carrier density of 10^{18} cm^{-3}, there are no carrier density dependence. The spin relaxation times are about one-tenth of those observed by PL measurement. For higher carrier density, spin relaxation rate seems to be saturated.

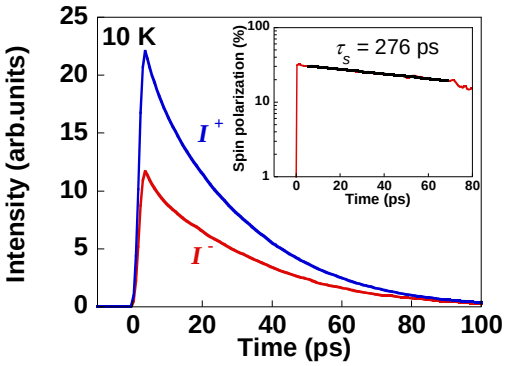

Fig.1 Time evolutions of the reflectance of cocircular (I^+) and anticircular (I^-) polarization at 10 K for the ecarrier density of 9.3×10^{17} cm^{-3} at 810 nm. The inset shows the time evolution of spin polarization.

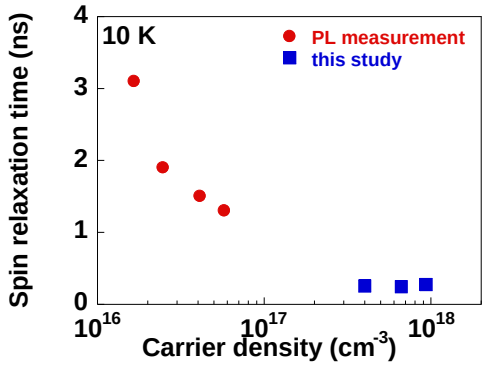

Fig.2 Carrier density dependence of the spin relaxation time at 10 K observed by PL measurement and in this study.

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