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InGaAs/GaAs 多重量子井戸のスピン緩和の観測

Observation of spin relaxation in InGaAs/GaAs multiple quantum wells

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InGaAs/GaAs multiple quantum wells (MQWs) have been applied to many optoelectronic devices such as solar cells,[1,2] photodiodes,[3] electro-optical modulators and switches.[4] Here, we report the observation of the spin relaxation in InGaAs/GaAs MQWs by time-resolved pump and probe measurement. [5]

The sample contains 3 periods of 7 nm thick $In_{0.425}Ga_{0.575}As$ wells and 20 nm thick GaAs barriers grown by molecular beam epitaxy on GaAs (001) substrate. An optical parametric oscillator pumped by a Ti-sapphire laser with a repetition rate of 80 MHz was used as the optical source for the pump and probe measurement. Initially, spin aligned carriers are generated in sample by circularly polarized pump pulse, and the circularly polarized time-delayed probe pulse reflected from the sample is then detected. Consequently, the population change of the spin polarized carriers is measured through the change of intensity of the probe pulses. The time resolution in this measurement system is 200 fs, which is determined by the convolution of the optical pulse width.

Figure 1 shows the observed time evolution of the reflectance at 10 K for the excitation power of 40 mW at 1123 mW. I^+ indicates a right circularly polarized excitation and a right circularly polarized probe. I^- indicates a right circularly polarized excitation and a left circularly polarized probe. The inset shows the time evolution of spin polarization. We observed the double exponential decay with the time constants of 28 ps and 135 ps. Figure 2 shows the excitation power dependence of spin relaxation time. The fast component and the slow component of spin relaxation decrease slightly as increasing the excitation power. This result indicates that Bir-Aronov-Pikus process [6] is an effective spin relaxation mechanism.

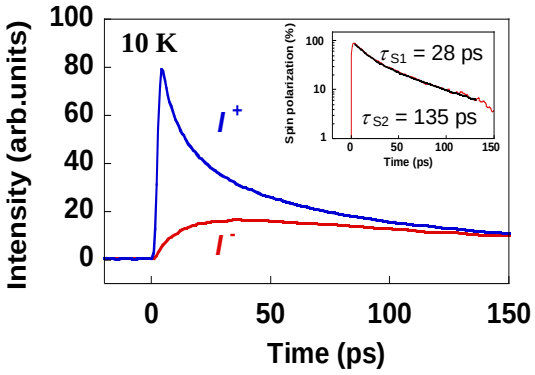

Fig.1 Time evolution of spin-dependent reflectance and the time evolution of spin polarization (inset) for the excitation power of 40 mW at 10 K at 1123 nm.

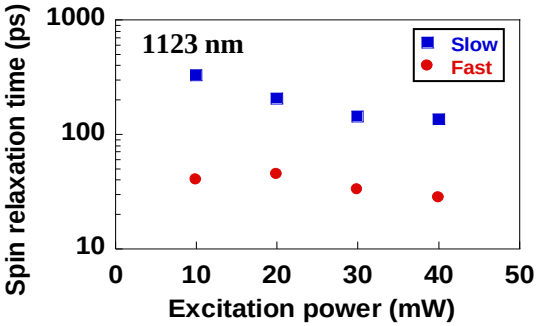

Fig.2 Excitation power dependence of spin relaxation time at 10 K at 1123 nm.

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