$CuInSe_2/CuGaSe_2$ 単一量子井戸の時間分解フォトルミネッセンス測定

Time resolved photoluminescence measurement of $CuInSe_2/CuGaSe_2$ single quantum well

○ショウ サンウ[1]、Sathiabama Thiru[2]、中村 芳樹[1]、堀越 佳治[1]、竹内 淳[1]

(1. 早大先進理工、2. UTM Razak School)

○C. Jiang[1], Sathiabama Thiru[2], Y. Nakamura[1], Y. Horikoshi[1], A. Tackeuchi[1]

(1.Waseda Univ. , 2. UTM Razak School)

E-mail: s112804036@akane.waseda.jp

$CuInSe_2$ (CIS) and related materials are leading candidates for low cost, high efficiency absorber layers for solar cells.[1] These materials can be also applied to variety of electro-optic devices.[1] However, the carrier lifetime of CIS/$CuGaSe_2$ (CGS) QWs has not been investigated yet. In this study, we report the carrier lifetime of CIS/CGS single QW obtained by time-resolved photoluminescence (PL) measurement.

A 500 nm thick-CGS layer, a 7 nm thick-CIS well layer and a 500 nm thick-CGS layer was grown on GaAs (001) substrate by employing the deposition sequence of migration enhanced epitaxy using molecular beam epitaxy system.[2] In this time-resolved PL measurement, a femtoseconds Ti-sapphire laser tuned to 760 nm was used as an optical source. After photo-excitation of the sample, PL was dispersed by the spectrometer and then detected by a streak camera with a time resolution of 15 ps.

Figure 1 shows the PL decay of the CIS/CGS QW when the excitation power is 30 mW at 10 K. The PL decay time is obtained to be 21.5 ps by a single exponential fitting. Figure 2 shows the temperature dependence of carrier lifetime. This result shows that the carrier lifetime increases as temperature increases. This behavior is similar to the case of Ⅲ-Ⅴ compound semiconductor QW such as GaInP/AlGaInP.[3] However, the present carrier lifetime of CIS/CGS QW is one order of magnitude shorter than that of Ⅲ-Ⅴ QW. The carrier lifetime of CIS thin film with Cu rich (Cu/In > 1) composition is reported to be 33 ps at 8.5 K.[1] The similarity of the short carrier lifetimes may indicate the contribution of non-radiative recombination.

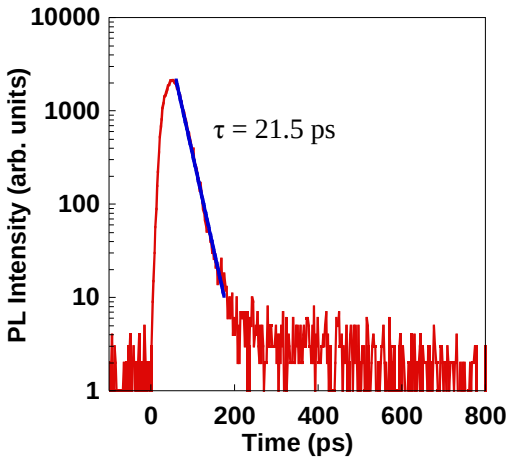

Fig.1 PL decay of CIS/CGS QW excited by 30 mW at 10 K. PL decay times evaluated by a single exponential fitting.

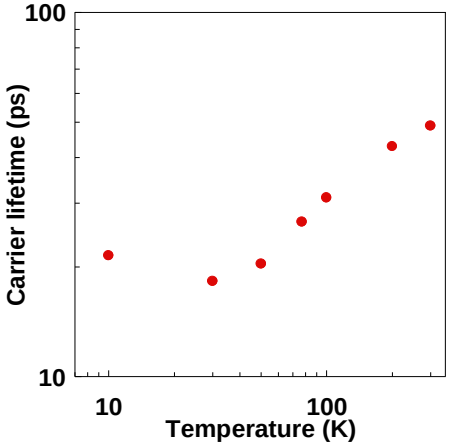

Fig.2 The temperature dependence of carrier lifetime at 30 mW.

[1] K. Puech et al., Appl. Phys. Lett. **69**, 22 (1996).
[2] S. Thiru et al., J. Crys Growth. **425**, 203 (2015).
[3] P. Michler et al., Phys. Rev. B. **46**, 7280 (1992).