TRPL Analysis of Intentionally N+B-Doped *n*-type 4H-SiC Epilayers

電中研[1]，産総研[2]，富士電機[3] ○楊 安麗[1]，宮澤 哲哉[1]，俵 武志[2,3]，村田 晃一[1]，土田 秀一[1]

CRIEPI[1], AIST[2], Fuji Electric Co., Ltd.[3], ○A. Yang[1], T. Miyazawa[1], T. Tawara[2,3], K. Murata[1], H. Tsuchida[1]

E-mail: yang-al@criepi.denken.or.jp

A reduction in carrier lifetimes by intentional B doping during epitaxial growth was previously reported [1]. Here, the related carrier capture/recombination mechanisms in intentionally N+B doped *n*-type 4H-SiC epilayers were investigated using time-resolved photoluminescence (TRPL) with two bandpass filters (BPFs). PL spectra showed mainly two luminescence peaks at RT, one of which band-edge luminescence peaking at 387 nm and another, D center-related green luminescence (e-A recombination) peaking at 523 nm [2]. Figure 1(a) shows the TRPL decay curves of band-edge luminescence of N+B-doped *n*-type epilayers dependent on temperature. The carrier lifetime (τ) was ~27 ns, which was shorter than the ~46 ns obtained without B doping at 300 K. The values of $1/\tau$ (corresponding to fast decays) match reasonably with the calculated capture rates ($\sigma_h \cdot \langle V_h \rangle \cdot N_T$) of the D center when σ_h and N_T are assumed to be between 10^{-15}-10^{-14} cm^2 and the D center concentration expected from the DLTS results for B-doped *p*-type samples, respectively. This suggested that the fast decay corresponding to the hole-capturing process by the D center, then the holes annihilated through e-A recombination. A slow decay appeared at 423 K and a higher temperature. Figure 1(b) shows how the TRPL decay curves of the D center-related luminescence depended on temperature for the same sample. The relatively slow decay curve at 300 K, in turn, indicates a relatively slow recombination rate through the e-A recombination path. It emerged that the effective decay time τ_{PL520}, which corresponds to the position of a maximum in $t \times I_{PL520}(t)$, unchanged against B concentration (2×10^{16} to 8×10^{16} cm^{-3}) but changed with N concentration. The decay constants accelerated when the temperature exceeded 373 K.

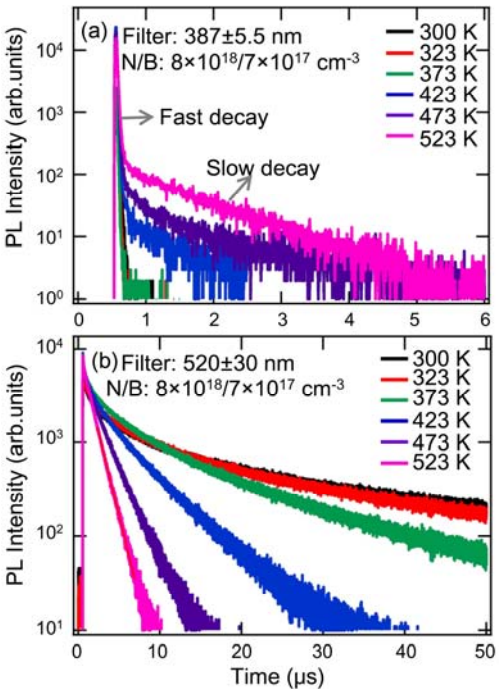

Fig.1. The temperature-dependent TRPL decay curves of an N+B doped epilayer.

Acknowledgements. This work was supported by Council for Science, Technology and Innovation (CSTI), Cross-ministerial Strategic Innovation Promotion Program (SIP), "Next-generation power electronics/Consistent R&D of next-generation SiC power electronics" (funding agency: NEDO).

[1] T. Miyazawa, T. Tawara and H. Tsuchida, Mater. Sci. Forum 897, 51 (2017).
[2] A. L. Yang, et al., Presented in the JSAP Autumn Meeting, 2016 (13p-B8-9).