Deep-level traps in as-grown and electron-irradiated n-GaN layers grown by MOVPE on Ammono-GaN substrate

P. Kruszewski*[1], J. Plesiewicz[1], V. P. Markevich[2], P. Prystawko[1], S. Bulka[3], M. Hallsal[2], I. Crowe[2], L. Sun[2], A. R. Peaker[2]

[1] Institute of High Pressure Physics, Polish Academy of Sciences, Sokolowska 29/37, 01-142 Warsaw, Poland
[2] Photon Science Institute and Department of Electrical and Electronic Engineering, the University of Manchester, Manchester, M13 9PL, UK
[3] Institute of Nuclear Chemistry and Technology, Dorodna 16, 03-195 Warsaw, Poland

*Corresponding author: kruszew@unipress.waw.pl
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In this paper, the results of junction spectroscopy measurements on deep-level defects in Metal–Organic Vapor-Phase Epitaxy n-GaN samples grown on highly doped Ammono-GaN and subjected to 1.5 MeV electron irradiation are compared. It is found that in addition to the commonly observed deep-level traps in n-type GaN, such as E1 (0.25 eV) and E3 (0.59 eV), 1.5-MeV electron irradiation introduces two other electron traps, EE1 and EE2, with electronic levels at about 0.14 and 0.98 eV below the conduction band edge (E_C), respectively. In the case of the EE1 level, a strong influence of the electric field (E) on the electron emission rate (e_{em}) is observed which suggests a donor type character of this trap level. Further, we have observed that strong electric field, as high as 2×10^5 V/cm, results in lowering the activation energy of electron emission from the EE1 level down to the value of 0.095 eV. The strong $e_{em}(E)$ dependence for the EE1 trap can explain the wide variation in electronic signatures of this trap reported in previously published publications. The analysis of the EE1 trap concentrations in the electron irradiated samples allowed us to estimate the average production rate of this trap by 1.5 MeV electrons as 0.125 cm^{-1} for n-GaN material grown on Ammono-GaN substrate. Possible origins of the detected deep-level traps are discussed.

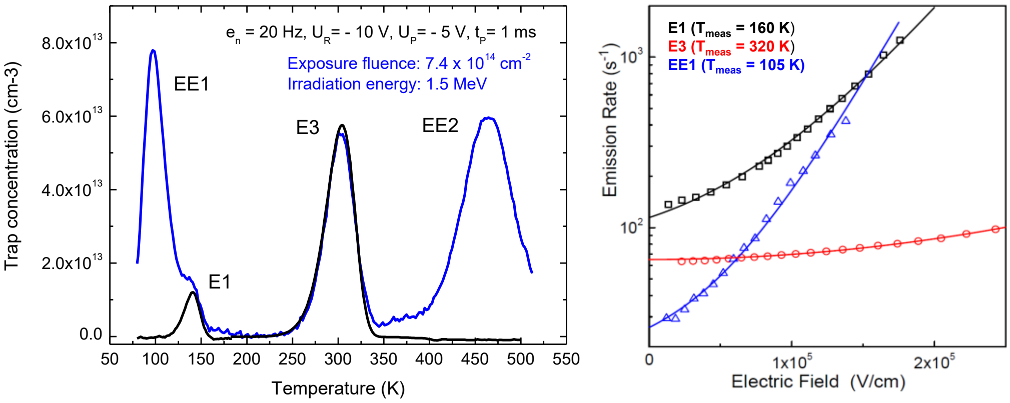

Fig. 1. On the left, the conventional DLTS spectra for both: reference sample (black curve) and 1.5 MeV electron-irradiated sample to dose of 7.4x10^{14} cm^{-2} (blue curve). On the right, the dependencies of the rate of electron emission from the E1, E3, and EE1 traps versus electric field strength in the depletion regions of reverse-biased Schottky diodes.

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