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УДК 621.921.34 538.93

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EXTREME HT-HP CONDITIONS FOR ACTIVATION OF NOTICEABLE OXYGEN DIFFUSION IN GaN

Oxygen diffusion in bulk GaN crystals was studied after HT–HP annealing at temperatures up to 3400 K and pressures up to 9 GPa. For this purpose, GaN crystals containing V-shape macro domains, *i.e.* overgrown pinholes with high oxygen concentration, were grown by Halide Vapour Phase Epitaxy (HVPE) method. Investigated HVPE GaN crystals before annealing showed sharp step-like oxygen concentration profiles on interfaces between pinholes and matrix. Oxygen concentration in overgrown pinholes is significantly higher ($N_O = (2–4)\times10^{19}$ cm^{-3}) than that in the bulk matrix ($N_O < 1\times10^{17}$ cm^{-3}) and directly corresponds to the free electron concentration in GaN. This characteristic was used to estimate the change of oxygen concentration profile due to annealing. Confocal micro-Raman spectroscopy was applied to measure the profiles of the free electron concentration, which is directly related to the concentration of oxygen impurity. Photo-etching method was used to reveal the pinholes in as-grown and annealed GaN samples and confocal micro-Raman spectroscopy was applied to measure their profiles of the free electron concentration across the pinhole-matrix interface. Lateral scanning across the interfaces between pinholes and matrix in the HVPE GaN crystals after annealing showed the diffusion blurring of the profiles. Analysis of the obtained data allowed for the first time for estimation of oxygen diffusion coefficients $D_O(T, P)$. The obtained values of $D_O(T, P)$ are anomalously small similarly to those, obtained by *Harafuji et al.* by molecular dynamic calculations for self-diffusion of nitrogen. Whereas oxygen and nitrogen are on the same sublattice it could explain the similarity of their diffusion coefficients. Results of this study also confirm the stability of the nitrogen sublattice of GaN against the formation of vacancies even at temperatures close to the melting point as *Harafuji et al.* theoretically predicted earlier.

Received 01.08.17