

The peculiarities of strain relaxation in GaN/AlN superlattices grown on vicinal GaN(0001) substrates

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GaN/AlN superlattices (SLs) are nowadays perspective for high-performance photonic devices operating in the spectral regions from ultraviolet to infrared [1]. Among other factors such as growth and design parameters, the structural and consequently optical properties of GaN/AlN SLs are strongly influenced by both the substrate type and strain relaxation in the SLs [2].

We present the peculiarities of strain relaxation in GaN/AlN SLs grown on vicinal GaN(0001) surface by plasma-assisted molecular beam epitaxy (PAMBE). Structural properties and evolution of the deformation state as a result of changes in the number of periods in GaN/AlN SLs is investigated by x-ray diffraction (XRD), x-ray reflectivity (XRR) and atomic force microscopy (AFM). In addition, from asymmetrical RSM (reciprocal space map) it was established, that the transition from coherent-to-noncoherent growth takes place after 10 SL periods. Simulation of XRD and XRR data give geometrical parameters of SLs. The deviation in thickness of the actual SL layers from nominal is explained by an exchange mechanism between Al adatoms and Ga surface atoms. The *ex-situ* analysis of strain, dislocation density, and densities of surface pits (cracks) are discussed taking into account the impact of the misoriented GaN(0001) substrate.

1. *Morkoç H.* Handbook of Nitride Semiconductors and Devices: Electronic and Optical Processes in Nitrides. Berlin: Wiley-VCH; 2008.
2. *Kladko V.P., Kuchuk A.V., Lytvyn P.M., Yefanov O.M., Safriuk N.V., Belyaev A.E., Mazur Yu.I., DeCuir Jr E.A., Ware M.E., Salamo G.J.* Substrate effects on the strain relaxation in GaN/AlN short-period superlattices // *Nanoscale Research Letters.*-2012.-7.-P. 289.