Structural and dynamical properties of short-period GaN/AlN superlattices: Experiment and theory

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We report the results of systematic experimental and theoretical studies of structural and dynamical properties of short-period GaN/AlN superlattices. The multilayer structures with the thicknesses of the constituent layers varying from two to several monolayers are grown using the submonolayer digital molecular beam epitaxy technique. In the framework of density functional theory, the lattice dynamics properties of the superlattices are studied. Good agreement between the experiment and theory is found, which made it possible to establish unambiguously a relationship between the features observed in the Raman spectra and the microscopic nature of the acoustic and optical phonon modes. The results obtained enhance the capabilities of Raman spectroscopy as a fast and non-destructive characterization method of short-period GaN/AlN superlattices and can be used to optimize growth process parameters for the fabrication of structurally perfect low-dimensional heterostructures.

Keywords: GaN/AlN superlattices, molecular beam epitaxy, group theory analysis, density functional theory, lattice dynamics, Raman spectroscopy.

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