VALENCE BAND STRUCTURE, OPTICAL TRANSITIONS, AND LIGHT GAIN SPECTRUM IN PSEUDOMORPHICALLY STRAINED ZINC-BLENDE GaN QUANTUM WELLS

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S u m m a r y

The influence of strains on the valence band spectrum, the interband matrix elements, and the light gain spectrum in zinc-blende GaN quantum wells has been studied. In the framework of the effective mass theory, the Schrödinger equation with a 3×3-block Hamiltonian was solved for the valence band. The results are illustrated for a $GaN/Al_{0.14}Ga_{0.86}N$ quantum well. It was found that, provided a biaxial compressive strain, the matrix elements of optical transitions from the heavy-hole subband correspond to a strict polarization of light in the quantum well plane. The large negative mass and the strong modification of the momentum matrix elements were connected to a biaxial tensile strain effects. The "random" double degeneration of spin-degenerate heavy- and light-hole states at the center of the Brillouin zone was found. The matrix element for the polarization in the direction perpendicular to the quantum well plane was found to be large. The biaxial strain was demonstrated to cause quite significant changes in the gain spectra of heterostructures. The tensile strain and the appearance of a circular loop of valence band maxima in the heterostructure were shown to be accompanied by a suppression of the laser effect. At the same time, the stimulated optical transitions are well pronounced at a compressive strain. Our results testify that internal strain effects are important for studying the optical properties of GaN and corresponding heterostructures.