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Design of advanced QW lasers based on BxInyGa1−x−yN/GaN operating in the UV spectral region

Abdenacer Assali[1,2]
[1]Ecole Nationale Polytechnique d'Oran, Algeria
[2]Centre de Développement des Technologies Avancées, Algeria

Electronic structure and optical constants of the dilute Boron-Indium quaternary alloy BxInyGa$_{1-x-y}$N lattice matched to GaN have been investigated using the density functional theory calculations within Full-Potential Linearized Augmented Plane Wave method with *x* and *y* concentrations varying up to 0.187. The exchange-correlation potential is described by the by the local density approximation (LDA) to calculate the structural properties. The new developed Tran–Blaha-modified Becke–Johnson (TB-mBJ) exchange potential is used to compute the electronic structure in comparison with the GGA and LDA approximations. The optical constants were calculated by the TB-mBJ exchange potential. The calculated structural parameters are found to be in excellent agreement with the experimental data. The TB-mBJ exchange potential gives the best results for the band gap energy. We find that B$_x$In$_y$Ga$_{1-x-y}$N alloy is expected to be lattice matched to GaN substrate for (x= 0.125, y= 0.187). The incorporation of B and In into GaN substrate allows to reduce it band gap energy in the structure of BxInyGGa$_{1-x-y}$N. In addition, the effect of B content on the optical properties of BxInyGa$_{1-x-y}$N is discussed with y= 0.187, which are dependent on the B incorporated. Quaternary alloy BxInyGa$_{1-x-y}$N lattice matched to GaN present a best properties including, high structural quality, small direct band gap and high refractive index. This makes BxInyGa$_{1-x-y}$N/GaN a promising material might be uses as an active layer in single quantum well for design high-efficiency solar cells and advanced UV laser diodes.

assali_nacer@yahoo.fr

Mid-infrared active scanning imaging with PbSnTe wavelength-tunable laser diodes grown via liquid-phase epitaxy

Arata Yasuda
National Institute of Technology, Japan

n-PbTe/*p*-PbSnTe/*p*-PbTe double-hetero (DH) diode structures on p-PbTe substrates were developed using the temperature difference method under controlled vapor pressure (TDM-CVP) liquid-phase epitaxy (LPE), which is a unique technique for stoichiometry control. We obtained high-quality PbTe or PbSnTe epitaxial layers and high-resolution tunable mid-infrared laser diodes (LDs) using this method. The lasing wavelength obtained by varying the ambient temperature of the diode was between 7.2 (1390 cm^{-1}) and 9.4 μm (1070 cm^{-1}). As its application in our previous study, we obtained a clear contrast absorbance image between the different resistivities Si wafers, some organic samples like benzoic acid (BA) or *para*-nitrobenzoic acid (PNBA) with the PbSnTe LDs. In the present study, we investigated the resolution of the PbSnTe mid-infrared laser active imaging systems. In addition, we introduced the results of some unique mid-infrared imaging for organisms. We use chicken liver and clover leaves as examples for medical application of imaging systems in the future.

y-arata@tsuruoka-nct.ac.jp