Hot-electron transport in graded AlGaN alloys

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Ternary wurtzite AlGaN is becoming of increasing importance in many semiconductor device applications. Three-dimensional electrons slabs (3DES) can obtained using the technique of polarization bulk doping in graded AlGaN semiconductor layer on GaN. In this work transport characteristics of the graded AlGaN are investigated experimentally through nanosecond-pulsed measurements of electron drift velocity. The measured drift velocity data are compared with that of GaN and ungraded AlGaN/GaN. Also, experimental results are compared with those of Monte Carlo simulation.

Performance of GaInNAs / GaAs Multi-Quantum Well Solar Cells

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In this study the basic principles multi-quantum well solar cells are investigated by measuring a GaInNAs/GaAs multiple quantum well (MQW) and a GaAs control solar cell. The MQW is identical to the control cell but with 10 10nm $Ga0.97In_{0.03}N_{0.01}As_{0.99}$ quantum wells in its intrinsic region. QE results show the addition of quantum wells extends the spectral response from 900nm to 1025nm which corresponds to the first subband in the GaInNAs wells.

AM1.5G 1 sun solar IV characteristics are measured at 25 °C and show the addition of quantum wells reduce the open circuit voltage and the short circuit current due to recombination in the wells. With values of being 0.9V and 0.685 V being achieved for the control and MQW device respectively. Additionally the fill factor is reduced to 69% due to carrier escape becoming more difficult as forward bias is applied. These factors combined lead to the MQW cell having an efficiency of 6.26% compared to 8.5 % for the control cell.

Comparison of band-structure approximations for GaN-based simulations

Daniel Robert Naylor

The band structure of Gallium Nitride is highly complex. In particular, it is known that the band structure around the Γ valley is highly non-parabolic. We investigate the cosine band-structure approximation for use in Monte Carlo models and make comparisons to existing models, such as the k.p approximation.

Band anticrossing in dilute bismide alloys: Tight-binding analysis

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We have developed an atomistic, nearest-neighbour sp^3s^* tight-binding (TB) Hamiltonian which has allowed us to calculate accurately the evolution of the electronic structure of $GaBi_xP_{1-x}$ and $GaBi_xAs_{1-x}$ with Bi composition. Supercell calculations allow us to trace the origin of the observed strong bowing of the band gap (E_g) and spin-orbit splitting (Δ_{SO}) in these alloys to a band anticrossing (BAC) interaction between the host matrix valence band maximum (VBM) and localised Bi-related defect states lying in the valence band (band gap) in GaAs (GaP) [1, 2].

We describe how we have used the TB Hamiltonian to explicitly identify the presence of both the Bi-related defect states and their interaction with the host matrix VBM in $GaBi_xP_{1-x}$. Next, we extend this analysis to $GaBi_xAs_{1-x}$, where our calculations indicate that the band gap decreases at a rate ~ 63 - 80 meV per % Bi for x ~< 13%, and that we should encounter a crossover at x ~ 10 - 11% Bi beyond which composition we have $Eg < \Delta_{SO}$. These findings are in good agreement with recent experimental studies [3].

References

[1] K. Alberi, et al., Phys. Rev. B 75, 45203 (1989)
[2] F. A. Trumbore, M. Gershenzon and D. G. Thomas, Appl. Phys. Lett. 9, 4 (1966)
[3] Z. Batool, K. Hild, T.J.C. Hosea, T. Tiedje and S. J. Sweeney, in preparation

The Dependence of Energy Band Gap on The Solar Cell Efficiency

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The poster shows a comparison of the two types of solar cells. In section 1 we cover a single p-n junction cell and its efficiency’s dependence on the concentration of the Sun’s irradiance. The second section covers the study of how the Multi-Junction solar cell works and theoretical study of the modeling of its efficiency providing information on choosing the right material combination.

Carrier Dynamics and Gain Characteristics of 1.3 μm GaInNAs Quantum Well Lasers on GaAs Substrate

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Electron transport dynamics in dilute nitrides

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