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Near-Infrared Emission Properties of GaAsBi-Based Devices under Electrical Injection

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GaAsBi is a promising material for near-infrared (NIR) emitters due to the large bandgap reduction with the incorporation of Bi, reduced temperature-induced emission wavelength shifts, and the possibility to suppress the non-radiative CHSH Auger recombination channel [1]. These properties make GaAsBi-based light emitting diodes (LED) and laser diodes (LD) attractive for NIR optoelectronic systems, including biomedical sensing, optical telecommunications, and LiDAR ranging. Therefore, it is important to evaluate device performance under electrical injection, as well as the possibility of transferring these structures onto other semiconductor platforms.

In this study, various GaAsBi-based LED and LD structures, incorporating an AlAs sacrificial layer, were grown by molecular beam epitaxy and investigated using electroluminescence (EL) spectroscopy. For the studied GaAsBi/GaAs multiple-quantum-well (MQW) LD structure, room-temperature emission at 1.26 μm was achieved, with the central emission energy shifting by −68 meV over the temperature range from 4 to 300 K. The flipped GaAsBi/GaAs MQW p-i-n LED structure, developed for flip-chip bonding [2], exhibited broader emission spectra and lower radiative efficiency than the standard n-i-p design. Photoluminescence measurements revealed that the lower-energy side of the EL spectrum in the p-i-n structure is broadened due to recombination through defect states, which may be associated with active-region deposition on low temperature growth p-type GaAs. In contrast, electronic-structure modelling with *nextnano* indicated that the high-energy tail likely originates from the first-electron–second-heavy-hole transition, enabled by hole concentration gradients formed through Be diffusion [3].

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