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Growth and characterization of dilute nitride materials for mid-infrared devices

InAsN(Sb) "dilute nitride" materials have been prepared and evaluated to establish their relative merits for use in mid-infrared (2-5 μm) light sources and photodetectors. The addition of small amounts (~1%) of nitrogen into III-V compound semiconductors substantially reduces the energy gapand results in a large band gap bowing, giving convenient access to longer wavelengths, interesting new fundamental physics and holds great potential for the development of novel devices. The manipulation of the electronic band structure of InAsN involves control of the interaction of the N-level with the extended conduction band states of InAs. The introduction of nitrogen significantly improves the temperature quenching of the photoluminescence emission. At low temperatures (T<80 K) and for low N content the photoluminescence emission results from radiative recombination involving localised tail states associated with disorder. As the N content increases the number of localised defect related levels increases. The conduction band moves below the localised states and the residual carrier concentration increases. Radiative recombination becomes a mixture of transitions from continuum states and localised states. Photoreflectance measurements reveal that increasing the nitrogen content above 0.5% reduces the band gap so that the energy gap, Eo becomes smaller than the spin orbit split-off energy gap, Δso, effectively detuning the CHSH Auger recombination mechanism. Hence, as the N content is increased up to 1%, InAsN samples grown on GaAs exhibit higher activation energies with respect to thermal quenching.

Biography

Tony Krier is Professor of Physics at Lancaster University where he is Director of the Quantum Technology Centre. He obtained his PhD in 1983 and joined Lancaster in 1989, where he founded the mid-infrared optoelectronics research group. He was promoted to Reader in 1999, then to Professor in 2003 and has published more than 170 papers. He has worked extensively on mid-infrared (2-5 μm) materials and devices and in 1996, he founded the international mid-infrared materials & devices conference (MIOMD). His recent work concerns antimonide nanostructures and dilute nitride alloys for use in mid-infrared lasers, photodetectors and solar cells.

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