Dilute-nitride materials for mid-infrared photonics

The development of the dilute-nitride Sb- and As-based materials is triggered by their unique capability to access spectral range above 3µm for emitters and near 10µm for detectors preserving advantages offered by III-V type-I QW or bulk materials. The corresponding material development efforts are challenging and require comprehensive technological and experimental studies.

MBE methodology was established for growth of dilute-nitride GaSbN and InAsN materials. Above 2% of nitrogen was incorporated into alloys.

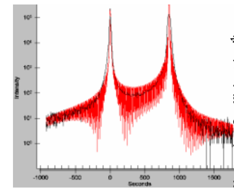
Absorption and photoluminescence measurements demonstrated the allowed character of band edge optical transitions in dilute-nitride GaNSb and InAsN bulk materials.

Gradual bandgap reduction with nitrogen content was observed: ~200meV (GaSbN) and ~70meV (InAsN) per percent of nitrogen.

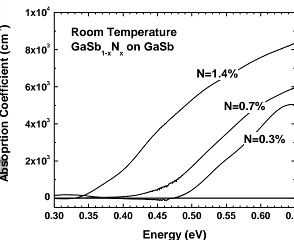
InAsN-based materials are currently being studied for the development of the nBn detectors.

GaSbN dilute-nitrides

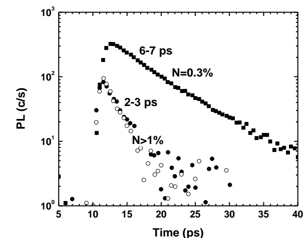
HRXRD for bulk N=1.4%



Absorption for bulk N=0.3-1.4%



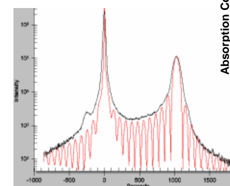
PL decay for bulk N=0.3-1.4%



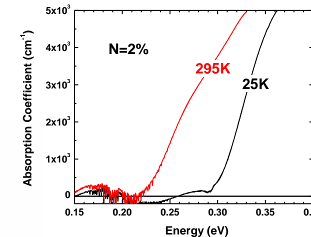
Bandgap reduction ~200meV/%. Carrier lifetime in ps range.

InAsN dilute-nitrides

HRXRD for bulk N=2.2%

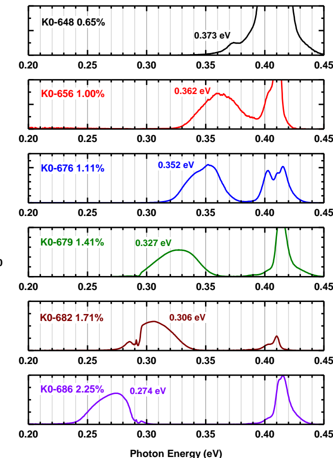


Absorption for bulk N=2%



PL spectra N=0.6-2.2%

25K



Bandgap reduction 70meV/%.

Equilibrium PL observed.