SUPERLATTICE QW STRUCTURE RESONANT TUNNELLING DIODE FOR THZ APPLICATION

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Introduction

Society needs fast wireless technologies to sustain the ever-growing wireless data traffic. InGaAs/AlAs/InP resonant tunnelling diodes (RTD) and RTD-based oscillators have proved to operate in the Terahertz spectrum at room temperature. Limitations arise from poor output power, degraded by epitaxial imperfections and ternary alloy scattering in the QW. We propose to replace the active region's ternary InGaAs with a superlattice (periodic combination of layers) made of binary InAs-GaAs separately. Binary compounds provide high-quality heterointerfaces and eliminate ternary scattering.

Methods

One standard InGaAs structure is used as a reference and compared with superlattice structures. Structures are designed to be equivalent in term of QW thickness and Indium mole fraction. Structural characterization is made by X-ray diffraction. The electronic characterization is performed by low-temperature photoluminescence spectroscopy (LT-PL). Device performances are investigated by the DC characterization.

Results

Figure-1 shows the QW band profile and PL characterization from the InGaAs reference structure and one representative superlattice design. The peak at ~0.8eV is associated with the bulk InGaAs lattice match on InP. Peaks at ~0.83eV and ~0.86eV are associated with the QW emission, and their position indicates similar electronic characteristics. At parity of LT-PL laser excitation power, the SL structure shows higher QW peak intensities, indicating better epitaxial quality.

Conclusion

We demonstrate an alternative approach for the design of high crystal-quality RTDs and their characterization by non-destructive techniques. The improved epitaxial quality aims at maximizing output power by reducing sources of electron scattering.