Long-Wavelength InAs-based Interband Cascade Lasers Grown by MBE

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Interband cascade lasers (ICLs) are becoming a leading semiconductor laser technology for the mid-infrared because of their high efficiency and low power consumption, especially as compared with conventional diode lasers and intersubband quantum cascade lasers (QCLs) in the wavelength range from 3-5 μm. Although a greater effort has been directed towards GaSb-based ICLs in the ~3-5μm range, recent work has highlighted the exciting potential for InAs-based ICLs for reaching longer emission wavelengths.

In this work we report the development of low-threshold InAs-based ICLs with a room-temperature emission wavelength of 6.3μm. The devices were grown on n+-InAs (100) substrates by solid-source molecular beam epitaxy in a custom V90 system using valved crackers for Sb_2 and As_2. The ICL structures employ an improved waveguide design using intermediate AlAs/AlSb/InAs strain-balanced superlattice cladding layers surrounded by heavily-doped n^+-InAs plasmonic claddings. The active region includes 15-stages with AlSb/InAs/In(0.35)Ga(0.65)Sb/InAs/AlSb type-II "W" quantum wells and optimized electron injector doping.

In pulsed mode, broad-area devices lased at 300 K at a lasing wavelength of 6.26 μm and a threshold current density of 395Acm^{-2} which is the lowest ever reported among semiconductor lasers at similar wavelengths. The broad-area devices lased up to 335K in pulsed mode at a wavelength of 6.45 μm. These results provide strong evidence of the potential for InAs-based ICLs as efficient sources in the mid-IR.

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