Type-I and type-II interband cascade lasers emitting below 3 µm

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The Sb-based type-II interband cascade laser (ICL) is recognised as the most efficient device for covering the 3-5 µm wavelength range. This structure has its performance sweet spot around 3.3-3.8 µm. Recent studies have significantly improved performance at wavelengths above 4 µm [1]. In contrast, little work has been done at wavelengths below 3 µm, where type I QW diode lasers are available. However, diode laser performance degrade above 2.5 µm, and the development of ICLs in this wavelength range could significantly improve laser performance.

As a case study, we compare the performance of ICLs designed for emission at 2.7 µm using type-II and type-I QWs. The ICLs are grown by molecular beam epitaxy on GaSb substrates.. They consist of two n-type AlSb/InAs superlattice claddings with a 5-stage interband cascade active region sandwiched between two separate n-type GaSb confinement layers. After growth, the structures were processed into 100 µm x 2 mm wide and 8 µm x 2 mm narrow ridge lasers. For the broad area lasers, the threshold current density at 20°C in pulsed regime was 90 and 260 A/cm2 for the type-I and type-II QWs, respectively. Figure 1 shows the P-I-V in CW for narrow ridge ICLs for different temperatures. The type-I ICL operates up to 55°C, while the type-II ICL does not exceed 45°C.

These initial results show that the use of type-I QWs below 3 µm can extend the benefits of the ICL design to shorter wavelengths and still improve performance in this wavelength range.

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