

# GaSb-based Interband Cascade Lasers with Hybrid Cladding Layers Operating in the 3-4 $\mu\text{m}$ Wavelength Region

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We report the demonstration of interband cascade lasers (ICLs) [1] with hybrid cladding layers [2-4] in the 3-4  $\mu\text{m}$  wavelength region. These ICLs were grown on GaSb substrates and employed  $n^+$ -doped  $\text{InAs}_{0.91}\text{Sb}_{0.09}$  cladding layers and n-doped  $\text{InAs}/\text{AlSb}$  superlattice (SL) intermediate cladding layers. In contrast to a regular ICL with only SL cladding layers, an ICL with the hybrid cladding layers can have an enhanced optical confinement and improved thermal dissipation. A room temperature (RT) threshold current density ( $J_{\text{th}}$ ) as low as  $177 \text{ A/cm}^2$  was measured for a broad area device emitting at  $3.28 \mu\text{m}$  (Fig. 1) with pulsed operation extending up to 390 K. The characteristic temperature ( $T_0$ ) was nearly 60 K, which is the highest value among RT ICLs with similar lasing wavelengths. ICLs from two wafers grown later exhibited a RT pulsed  $J_{\text{th}}$  as low as  $151 \text{ A/cm}^2$  for emission near  $3.82 \mu\text{m}$  (Fig. 2), which is comparable to the best ICLs with only SL cladding layers [5]. Considering the substantial deviations ( $>10\%$ ) in the grown layer thicknesses from the design values, it is expected that ICLs with hybrid cladding layers will have significantly better performance once the growth process is improved. Updated results will be reported at the conference.

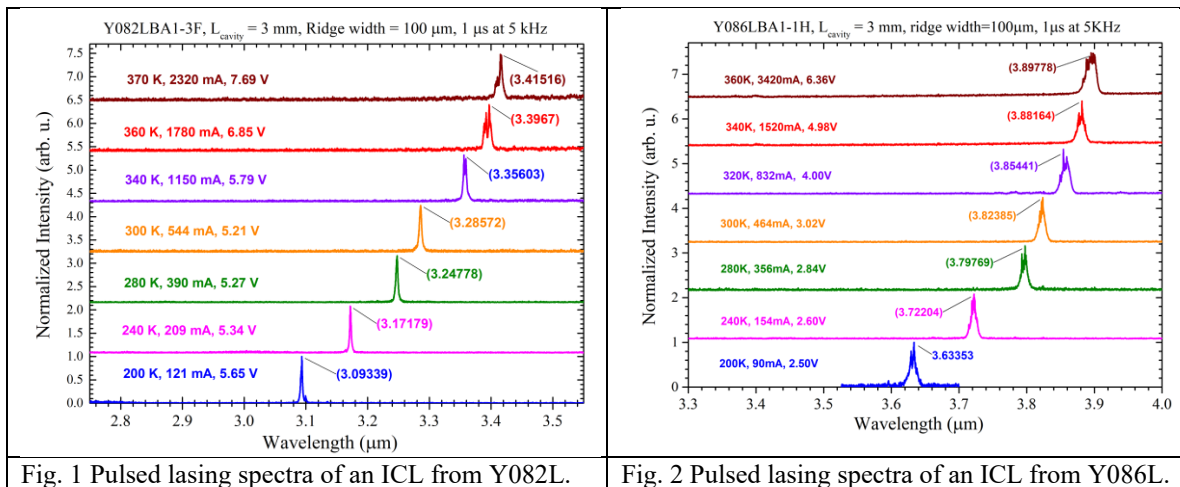


Fig. 1 Pulsed lasing spectra of an ICL from Y082L.

Fig. 2 Pulsed lasing spectra of an ICL from Y086L.

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