# GaSb-based ICLs grown on GaSb, GaAs and Si substrates

**M. Fagot, D. Díaz-Thomas, A. Gilbert, G. Ndemengoye, Y. Rouillard, A.N. Baranov, J.B. Rodriguez, E. Tournié and L. Cerutti+**

*IES, Univ. Montpellier, CNRS, 34000 Montpellier, France.*

GaSb-based Interband Cascade lasers (ICLs) have emerged as the leading optoelectronic source in the 3-6 µm wavelength range **[1]**. Although ICLs are very attractive for various applications such as laser spectroscopy or free-space communication, the cost and size of substrates pose a significant limitation to their widespread commercialization. However, recent studies have shown that the unique band diagram of the ICLs active zone, is tolerant to mid-gap defect states induced by dislocations [2]. Thus, the growth of ICLs on large, inexpensive, and mismatched substrates presents a viable solution for the low-cost production of high-performance mid-infrared (MIR) lasers and MIR photonic sensors on GaAs or Si-photonic integrated circuits (PIC).

In this study, we have examined the performance of ICLs designed to emit at 3.3 µm, which were grown simultaneously on GaSb, GaAs, and on-axis Si (001) substrates. The ICL structures consisted of two n-type AlSb/InAs superlattice claddings and a 5-stage interband cascade active region sandwiched between two n-type GaSb separate confinement layers. After the growth, the structures were processed into 8 µm x 2 mm laser devices and bonded epi-side up, with the bottom contact taken into the bottom cladding.

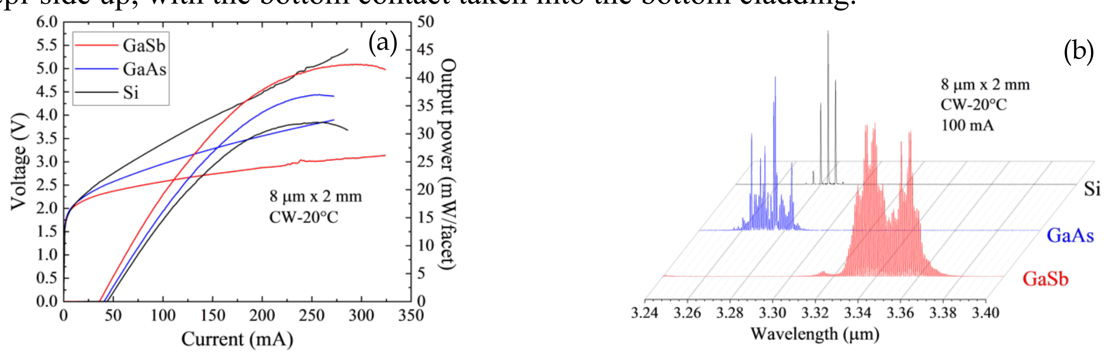


Figure 1: P-I-V (a) and spectra (b) of ICLs grown on GaSb, GaAs and Si measured in CW at 20°C

All the lasers operated in the continuous wave (CW) regime at RT and emitted around 3.3 µm (Fig.1). The threshold current is approximately 40 mA whereas the maximum output power decreased from 42 mW for the lasers on GaSb to 37 and 32 mW for the devices on GaAs and Si substrates, respectively (Fig.1). We attribute the observed decrease in the optical power to a higher voltage drop which results in overheating of the active region. The higher series resistance in these devices can be explained by poorer lateral electrical conductivity of the cladding in presence of threading misfit dislocations in the mismatched structures. These encouraging results open the way to the development of low cost ICLs and integrated photonic sensors for PIC.

[1] J. R. Meyer et al., Photonics. **7**, 75, p. 2-58 (2020).
[2] L. Cerutti et al., Optica. **8**, 11, 1397 (2021).

This work was partially supported by the French "Investment for the Future" program (EquipEx EXTRA, ANR-11-EQPX-0016), the French Occitanie Region (LASIDO project) and the French Agency for Defense and Innovation (AID-DGA).

+ Author for correspondence: laurent.cerutti@umontpellier.fr