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# Type-II Interband Cascade Laser Monolithically Integrated on Si Substrate

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**Abstract** — We present recent advances in type-II interband cascade lasers (ICLs) emitting in the 3–5  $\mu\text{m}$  range, grown on silicon substrates that show tolerance to threading dislocations. The demonstration of single-mode distributed feedback (DFB) ICLs on silicon highlights their potential for integrated optical sensors in silicon photonics platforms.

**Keywords**—III-V Laser on Silicon; Mid-Infrared; Interband Cascade Lasers;

Today, the interest in developing innovative photonic devices in the mid-infrared (mid-IR) wavelength range is growing rapidly due to the increasing demand for gas monitoring in industrial, medical, and defense applications, or for the development of free-space communications [1,2]. In addition, the integration of mid-IR lasers on Si enables their realisation on large and low-cost substrates with the ultimate goal of developing chip-scale photonic integrated circuits (PICs) [3]. Despite recent efforts to monolithically integrate III-V lasers on Si, several challenges remain due to the presence of various defects, such as the dislocations, which affect the performance and the lifetime of the lasers.

In this presentation, we will show that type-II interband cascade lasers (ICLs) are tolerant to mid-gap defect states induced by dislocations, thanks to the specific band diagram of their active region. Indeed, we have demonstrated ICLs emitting between 3.3 and 5  $\mu\text{m}$  on mismatched substrates [4-6], with performance similar to those on native substrates. These ICLs exhibited long lifetime operation despite a high density of threading dislocations. As single mode emission is required for laser spectroscopy, we will also present the development and the performance of a distributed feedback (DFB) technology on ICLs grown on Si [5].

All these results pave the way for the development of low-cost ICLs and are the first step towards the realization of optical gas sensors on Si PICs

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