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## Ring interband cascade lasers for trace gas sensing

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Interband cascade lasers (ICLs) [1,2] combine the concept of quantum cascade lasers (QCLs) and conventional photodiodes, because they rely on the voltage-efficient in-series connection of multiple active regions as in QCLs as well as the long upper-level recombination lifetimes of photodiodes. The distinctive low power consumption of ICLs makes them especially attractive for mobile applications in the mid-infrared, such as process control, medical applications and spectroscopy [3].

This work aims to give a short introduction to the field of ICLs with a strong focus on our research on ring devices. Their potential for spectroscopic applications will also be evaluated.

As a first proof of principle we present ICLs fabricated into ring-shaped cavities [4]. For the light outcoupling of our ring ICLs we use a second order distributed feedback (DFB) grating [5] in order to achieve vertical light emission through the GaSb substrate. The first demonstrated devices with 400µm outer diameter and a waveguide width of 10µm show light emission at a wavelength of ~3.7µm. A pulsed threshold current density <1kA/cm$^2$ is measured at 20 C.

We are using our ICLs for trace gas sensing via the principle of photothermal interferometry and show first results of such measurements based on ICLs. Trace gas detection using 2*f*-wavelength modulation Fabry-Perot photothermal interferometry has already been reported with a QCL as excitation source [6].

In addition, we are investigating the suitability of related concepts that have already been used for ring QCLs and implement them to our ring ICLs. Two-dimensional DFB laser arrays have, for example, been realized for ring QCLs [7], exhibiting a broad spectral tuning range.

**References:**

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