Why Fraunhofer IAF?

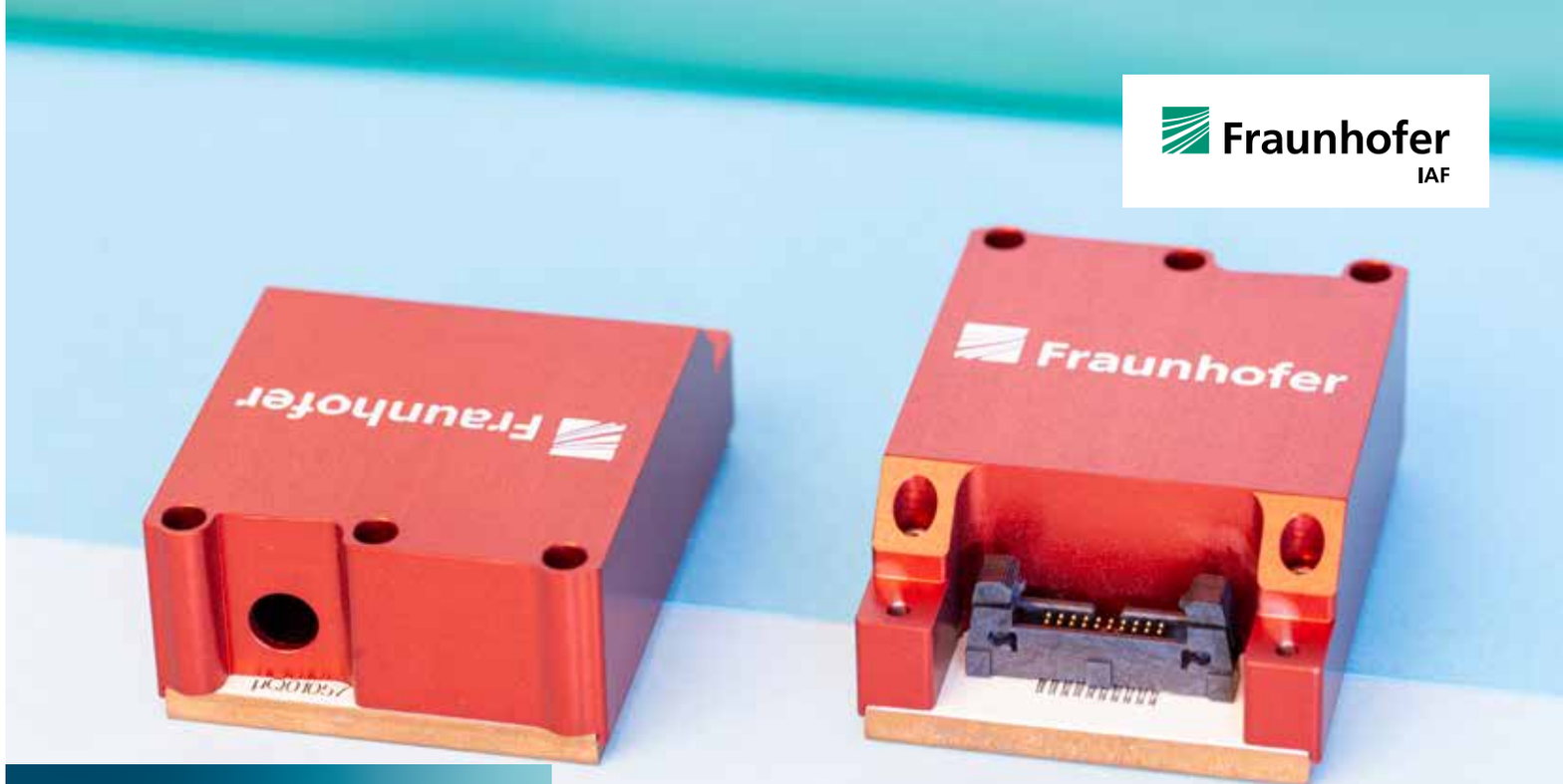
Together with national and international partners from science and industry, Fraunhofer IAF plays a leading role in the development of customized semiconductor laser components and systems for various applications. Thanks to the expertise of its researchers, its large network, and its unique research infrastructure, the institute covers the entire value chain: from design, epitaxy, process, structure, coating, characterization, and module development up to application systems.

In addition, Fraunhofer IAF has decades of experience in running complex international research projects and collaborations with customers from industry and small and medium-sized enterprises. This enables an equally efficient and flexible cooperation in the application-oriented research and development of innovative optoelectronic technologies as well as in the customized implementation of orders.

What we offer:

- Central wavelengths in the range of 4–11 µm
- Compact and robust design due to the use of MOEMS grating scanners
- Different spectral scan speeds: 0–50 Hz or ~1 kHz
- Pilot series production
- Application development

Would you like to learn more about our research activities and range of services in the field of miniaturized quantum cascade laser modules? We will be happy to present our work and various cooperation opportunities to you in person.



Fraunhofer IAF

Contact

Dr. Marko Härtelt
Business Unit
Optoelectronics
Phone +49 761 5159-315
marko.haertelt@
iaf.fraunhofer.de

Fraunhofer Institute for
Applied Solid State Physics IAF
Tullastrasse 72
79108 Freiburg, Germany
www.iaf.fraunhofer.de/en

Compact modules with broad spectral tunability

µQ — Miniaturized quantum cascade laser modules

Compact laser systems for mid-infrared spectroscopy

Fraunhofer IAF develops tunable quantum cascade lasers (QCLs) for the mid-infrared range. Particularly compact laser modules with unique properties are achieved by combining broadband QCL chips with MOEMS grating scanners to adjust the emission wavelength in an external optical resonator.

Combining QCL chips and MOEMS grating scanners

Two different spectral tuning concepts were developed together with Fraunhofer IPMS, resulting in resonant and non-resonant MOEMS scanners. Resonant grating scanners enable very high spectral scan speeds of up to 1 kHz and are therefore ideal for real-time spectroscopy. Non-resonant grating scanners, on the other hand, enable spectral scan speeds with repetition rates up to several 10 Hz. In addition, these scanners allow for programmable and flexible wavelength tuning trajectories as well as to approach individual emission wavelengths.

Fields of application

- Production: Inline-capable backscatter spectroscopy systems for industrial quality assurance and process control
- Security: Hand-held detection systems for immediate stand-off identification of chemical and biological materials in real-time

QCL chips

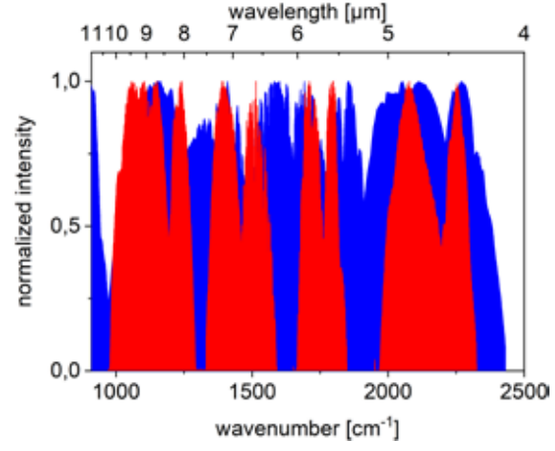
- Material: AlGaAs/InGaAs on InP
- Central wavelengths: 4–11 µm
- Power/Spectral coverage
  - Pulsed:
    - Spectral coverage: 200–300 cm^{-1} (typ.)
    - Line width < 2 cm^{-1}
    - Average optical output power 10 to > 100 mW (depending on wavelength)
  - CW:
    - Spectral coverage > 100 cm^{-1} (typ.)
    - Line width < 90 MHz (typ.)
    - Power: several 100 mW
- Gaussian beam profile: $M^2 < 2$ (typ $M^2 < 1.5$)
- Beam size: < 3.5 mm ($1/e^2$)
- Polarization: linear, vertical

MOEMS scanner

- Resonant:
  - Trajectories sinusoidal
  - Frequency: 1 kHz
- Non-resonant:
  - arbitrary, or selection of individual wavelengths
  - Frequencies: 0 … ~ 50 Hz
- Integrated position sensor for wavelength determination
- Blaze and lattice constants adapted to spectral ranges of the QCL chip

Module

- Size (L × W × H): 60 mm × 45 mm × 20 mm
- Laser driver:
  - Pulsed: integrated in the module
  - CW: integrated in the module or separately (depending on max. required current)
- Electronics:
  - OEM electronic controller
  - Integrated temperature controller
  - Programmable pulse source and laser current source



Examples for tuning ranges of pulsed (blue) and CW-tested (red) quantum cascade laser chips