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Monolithically integrated extended cavity diode laser (mECDL)

Extended cavity diode lasers (ECDLs) are compact, robust and efficient light sources with ultra-high frequency stability. They are ideally suited for the next generation of photonic integrated systems such as optical atomic clocks for global navigation satellite systems and quantum sensors based on atom interferometry. The FBH has successfully transferred the ECDL concept onto a single chip by means of an innovated two-step growth process in the gallium arsenide material system.

The novel monolithic solution (mECDL) allows for cost-effective wafer-scale production, improved mechanical robustness and thermal wavelength tuning on millisecond timescales. Devices near 1064 nm and 778 nm have been realized successfully for frequency standards based on molecular iodine and rubidium, respectively.

Advantages

- ultra-narrow linewidth
- extremely compact & mechanically robust
- wafer-scale production
- faster thermal wavelength tuning

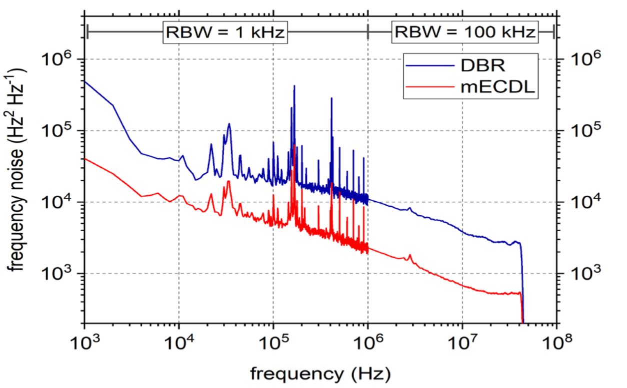
Specifications

1064 nm

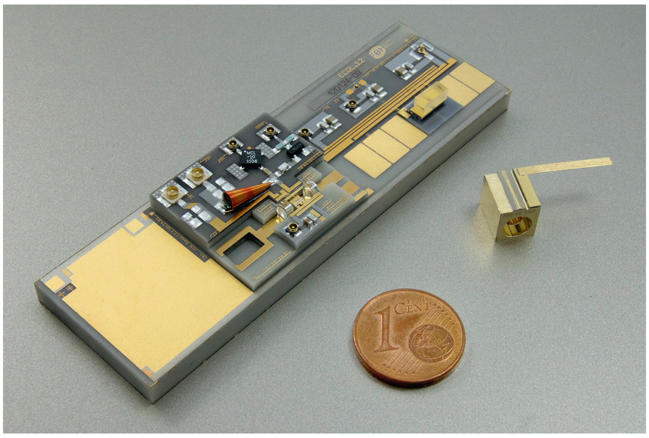
- 40 mW opt.power @ 200 mA
- 25 kHz @ 1 ms FWHM linewidth
- 1.6 kHz intrinsic linewidth

778 nm

- 30 mW opt.power @ 175 mA
- 200 kHz @ 1 ms FWHM linewidth
- 6 kHz intrinsic linewidth



Comparison of frequency noise spectra between previous state-of-the-art chip-scale solution (DBR laser) and mECDL at 1064 nm.



Extended cavity diode laser (micro-integrated vs. monolithic).

Applications

- optical atomic clocks for global satellite navigation
- laser communication terminals for coherent free-space data transfer
- quantum sensors based on atom interferometry for fundamental physics research, earth observation, and exploration of natural resources

Profile

The Ferdinand-Braun-Institut, Leibniz-Institut für Höchstfrequenztechnik (FBH) researches electronic and optical components, modules and systems based on compound semiconductors. In the field of III-V electronics, it manufactures high-frequency devices and circuits for communications, power electronics, and sensor technology. Moreover, FBH develops light sources from the visible to the UV spectral range: high-power diode lasers, UV light sources, and hybrid laser systems. Applications range from medical technology, materials processing and sensors to optical communications in space and integrated quantum technology. In close cooperation with industry, its research results lead to cutting-edge products.

The institute is a member of the Leibniz Association and part of Research Fab Microelectronics Germany (FMD).