Bachelor / Master Thesis:

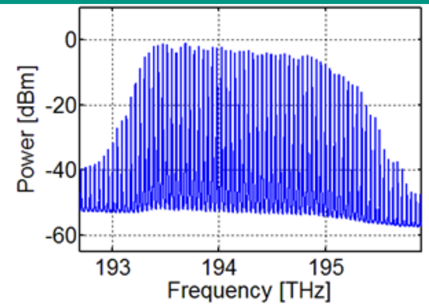
THz carrier generation based on self-injection locked III-V mode-locked laser diode with a Si_3N_4 feedback circuit

Introduction

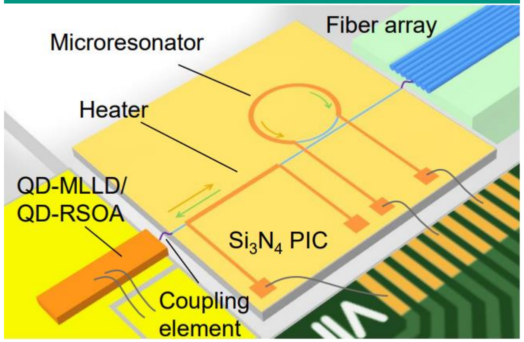
Terahertz (THz) carrier generation is pivotal in various applications, including communication, imaging, and spectroscopy. However, generating THz signals poses significant challenges, primarily due to the high frequencies involved, which are beyond the capabilities of conventional electronic oscillators. To overcome these challenges, photonics-based THz generation by heterodyning two narrow linewidth lasers is an appealing approach [1].

Here, we propose a THz source based on a hybrid integrated self-injection locked mode-locked laser diode (MLLD) using photonic wire bonding [2]. By exploiting the resonant enhanced Rayleigh backscattering in a high-quality factor Si_3N_4 ring resonator as the optical feedback to the MLLD, two longitudinal modes with frequency spacing at THz will be simultaneously injection-locked, thereby allowing for significant optical linewidth reduction of the two locked comb tones. A low-phase noise THz carrier can be achieved by heterodyning the two comb tones with a uni-travelling-carrier photodiode. Our proposed scheme opens new opportunities for diverse THz applications that requires low phase noise THz carriers.

Spectrum of mode-locked lasers



Concept of comb-based THz source



Your tasks

- Mode-locked laser and Si_3N_4 chip characterization
- Fabrication of the hybrid multi-chip integrated module
- Characterization of the integrated module

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[1] Chen, Y. et al. Self-Injection-Locked Kerr Soliton Microcombs With Photonic Wire Bonds For Use in Terahertz Communications. STh3J.1, CLEO 2023
[2] Blaicher, M. et al. Hybrid multi-chip assembly of optical communication engines by in situ 3D nano-lithography. Light Sci. Appl. 9, 2047–7538, 2020.