Frequency stabilization of a hybrid-integrated InP-Si_3N_4 diode laser

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Diode lasers in the visible and the infrared based on hybrid integration of a semiconductor optical amplifier with a long and low-loss Si_3N_4 frequency-selective circuit have the advantage of generating narrow intrinsic linewidths in the kHz range [1] and even down to 40 Hz [2]. This high level of frequency stability on short timescales benefits short-term measurements, such as for interferometry and coherent data communication. However, as with all lasers, technical noise and long-term drifts are present, increasing the linewidth on longer timescales.

We present our investigation into stabilization schemes by locking an InP-Si_3N_4 hybrid-integrated laser to an absolute frequency reference, e.g., to absorption lines of acetylene (C_2H_2) in the laser's infrared emission range. The laser is frequency controlled via the diode current and by thermal tuning of integrated microring resonators and a cavity phase section. We discuss the optimal way to stabilize the laser frequency through feedback on these controls. Experimental results on the frequency stability over longer terms will be presented.

[1] C.A.A. Franken, A. van Rees, et al., arXiv:2012.04563v2 (2021)
[2] Y. Fan, et al., Opt. Express 28, 21713 (2020)