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InAlGaN laser diodes for quantum photonics

In this work, we present our development of nitride laser diodes, Fig. 1(a), for application in quantum technologies. The target parameters include high optical power, a high-quality single-mode optical beam, improved temperature stability, and compatible optical amplifiers.

We first demonstrate our approach for obtaining improved temperature stabilization of the laser diodes through the use of polarization doping. The mechanism utilizes the spontaneous and piezoelectric polarization present in wurtzite structures and allows even for blue lasing under cryogenic ambient temperatures [1]. Next, we focus on achieving narrow emission linewidths. The demonstrations involve distributed feedback (DFB) lasers [2] as well as coupling to SiN ring resonator – Fig. 1(b). We then show the possibility of increasing the optical power through a semiconductor optical amplifier [3], increasing the output power from 5 mW up to 150 mW. Finally, we present a novel approach for fabrication of integrated nitride semiconductor waveguides, which open a path for light processing within the same chip as the laser diode. The solution is based on introducing a lateral variation of the In content in the InGaN QWs and allows us to achieve low-loss waveguides, Fig. 1(c) despite using the laser epitaxial structure.

References

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Figures

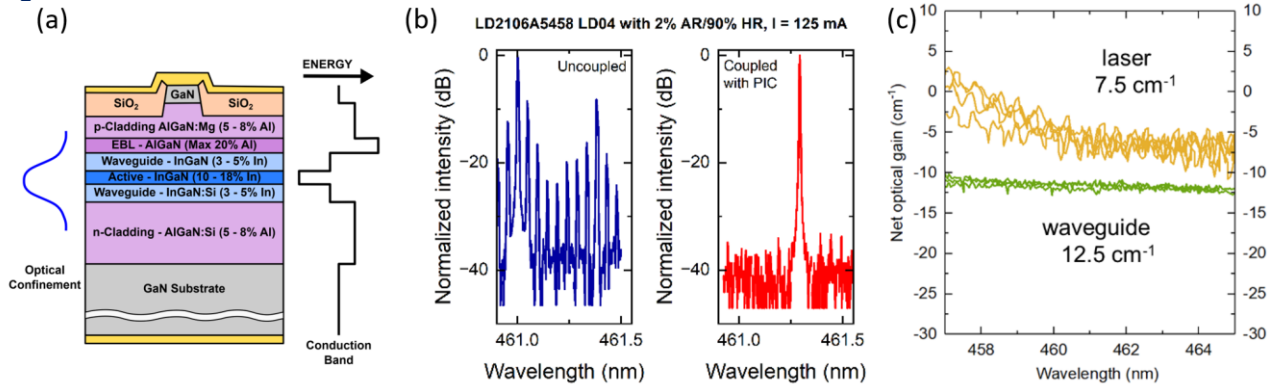

Fig. 1 (a) Schematic structure of a typical InAlGaN laser diode. (b) Example of a narrow emission linewidth of an InAlGaN laser + SiN micro resonator system. (c) Losses measured for a laser plus waveguide system and for a reference laser.