Distributed Feedback InGaN Laser Diodes Grown by Plasma Assisted Molecular Beam Epitaxy

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Distributed feedback (DFB) laser diodes (LDs) offer a single wavelength emission spectra with a very high signal to noise ratio. This is a much desired feature in many applications such as telecommunication, gas sensing, interferometry and atomic clock cooling. The DFB LDs are available in a broad spectral range from λ=760nm to λ=16μm.

The III-nitride material system has shown to be capable of providing LDs in the range of λ=380nm to λ=530nm. Fabrication of a III-nitride DFB LD would extend the available spectral range of single wavelength sources to visible light. Unfortunately, realization of a DFB LD based on III-nitrides encounters many, difficult to overcome, material obstacles. The past two years had renewed the interest in III-nitrides DFB LDs thanks to some technological solutions based on fabrication of a laterally-coupled grating [1, 2].

In this paper we will present a novel method of fabrication of a DFB LD. It is based on a strong coupling between the optical mode and grating formed directly on top of the mesa. This is possible thanks to the use of plasma assisted molecular beam epitaxy (PAMBE) to grow the laser diode terminated with a tunnel junction (TJ) [3]. Incorporation of a TJ enables to change the conductivity type from hole to electron. This allows to move the top metallization of the device to the side of the mesa structure, leaving it exposed to air. Having the metallization on the side the grating can be placed directly on the mesa. Optical simulations of coupling strength of this design will be presented.

We will demonstrate an electrically-driven DFB laser diode operating at λ=450nm with a very good single wavelength characteristics. The obtained results will be compared with standard LDs with a Fabry-Perot resonator.

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[1] T. J. Slight, O. Odedina, W. Meredith, K. E. Docherty, and A. E. Kelly, IEEE Photonics Technology Letters 28, 2886-2888 (2016).
[2] J. H. Kang, M. Martens, H. Wenzel, V. Hoffmann, W. John, S. Einfeldt, T. Wernicke, and M. Kneissl, IEEE Photonics Technology Letters 29, 138-141 (2017).
[3] C. Skierbiszewski, G. Muziol, K. Nowakowski-Szkudlarek, H. Turski, M. Siekacz, A. Feduniewicz-Zmuda, A. Nowakowska-Szkudlarek, M. Sawicka, and P. Perlin, Appl. Phys. Express 11, 034103 (2018).