# New generation of near-UV Laser Diodes by Plasma Assisted MBE

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The ultraviolet (UV) laser diodes (LDs) attract attention due to their wide range of applications, e.g. in the field of gas detection, lithography, biomedical, 3D printing, purification, sterilization etc. In this paper we will focus on group-Ill nitride-based LDs operating in the near ultraviolet range. Interestingly, despite the abundance of potential applications and significant resources devoted to development of UV LDs, their commercial success is yet to come. There are a number of issues which hinder their implementation in many potential applications. Some of those are: i) lack of proper substrates – devices grown on standard GaN substrates suffer from large band-to-band light absorption, ii) lattice mismatch between AlGaN claddings and GaN substrates – significant strain leads to relaxation through generation of extended defects, and iii) increased degradation rate for short-wavelength LDs.

In this work we focus on novel architecture of UV LDs with GaN quantum well (operating at $\lambda$=360 nm). Instead of classical LD structure with GaN waveguides and AlGaN claddings (Fig.1a) we used an AlGaN waveguide and air claddings (Fig. 1b). The structure of LDs is grown by plasma assisted molecular beam epitaxy (PAMBE). The upper air cladding is created by implementation of the tunnel junction (TJ), which allow for side contact deposition (outside of laser ridge). The air above mesa acts as upper cladding. The bottom cladding is made from low Al content porous AlGaN. The proof of concept of LDs with TJ and bottom porous GaN claddings was already demonstrated for true-blue LDs grown by PAMBE [1-2].  We will discuss the development of low resistance AlGaN/AlGaN TJ which do not absorb 360 nm UV light as well as electrochemical etching of nanoporous AlGaN cladding. The simulation of laser diode optical mode confinement, absorption losses for different parameters of TJ and AlGaN cladding porosification will be shown.

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[1] M. Sawicka et. al., Optics Express 30, 10709 (2022)
[2] G. Muziol et. al., Optics Express 28, 35321 (2020).

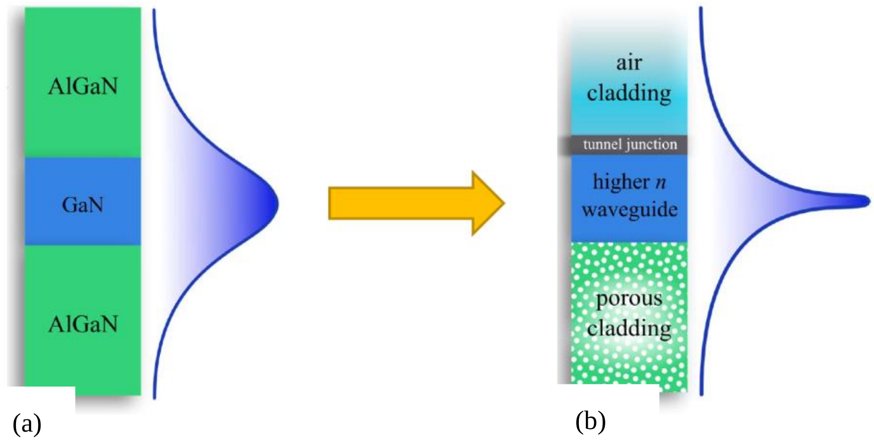


Fig. 1: Comparison of standard LD with AlGaN claddings (a) and LD with air claddings (b)