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# Study of impact of art performance level of blue laser technology applications and its control

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**ABSTRACT**

In this work; we present an enhancement in blue laser diodes with new factors and applications for modern technology such as underwater telecommunications, bio-sensor and bio-medical systems etc. Years of advance meanwhile have much enhanced laser performance, and extremely improved their diversity, making lasers significant parts in scientific research, telecommunications, engineering, bio-medical imaging, materials working, and a swarm of other applications. This article viewing how laser technology has progressed to chance application requirements. The enhanced blue laser building diagrams to get a peak efficiency % at room temperature with modification. Moreover, we have as well estimated electro-optical performance packing of blue laser diodes been significantly various associated to GaAs laser method and novel developments and performances are required to enhance the optical power from anther laser diodes. Researchers need enhanced approaches to accurately make new the blue laser applications to use control of modern experimental measurements and optical communication.



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## 1. INTRODUCTION

Blue beams are formed by gas lasers using He-Cad at 441.6 nm, and Argon-ion at 458-488 nm. Semiconductor with blue rays are naturally depending on gallium nitride. Both blue and violet lasers can also be built by means of frequency repetition of IR laser $\lambda$ from DL or DPL [1].

In the early 1990s the Institute of High Pressure Physics of Dr. Sylwester established knowledge to make gallium nitride quartzes with high organizational excellence [2-4]. For example, diode lasers are semiconductor devices, they may as well be divided as semiconductor lasers [5].

## 2. METHOD AND RATE EQUATIONS OF THE MODELING BLUE LASER

A laser diode is formed like a plane-paralleled rectangle where the two faces, semiconductors see, form a Fabry-Pérot resonator. This resonator is the source of the emission moved by distinguishing light emission as shown in Figure 1 [6]. From Figure 2 & 3 shows energy level of DH-OS Laser Diode and the circuit of blue laser diode. To get a continua land powerful laser of the junction of semiconductors [7].

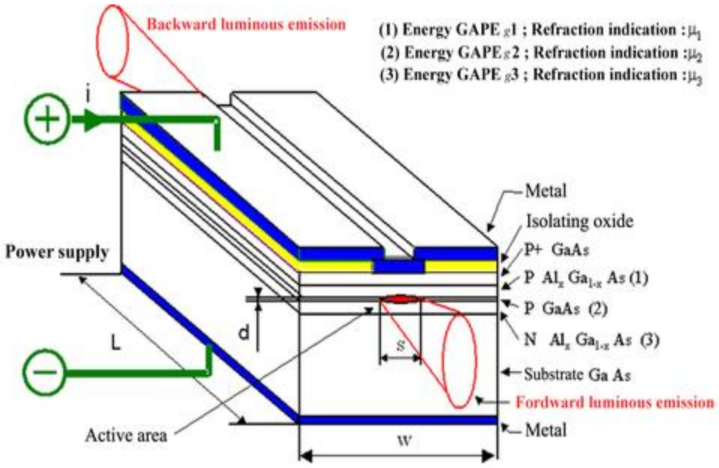


Figure 1. Schematic of DH-OS laser diode

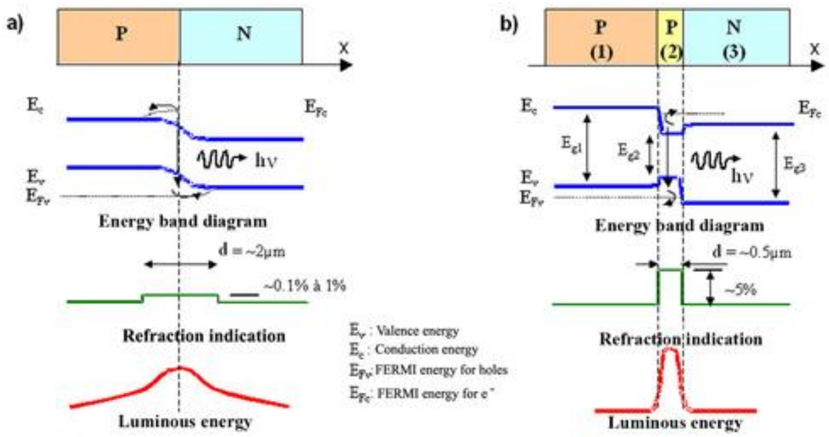


Figure 2. (a) PN-junction of LD, (b) Energy level of DH-OS laser diode [8]

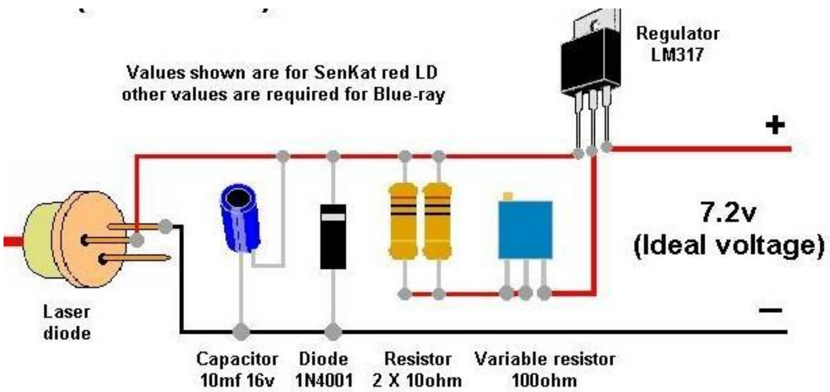


Figure 3. The circuit of blue laser diode [9]

Electrical pumping is usually achieved by means of sufficiently intense electrical discharge. Electrical pumping is well-organized for gases and semiconductors, whose absorption BW is extensive enough. While around optical pumping approaches for semiconductor intermediate have been advanced, electrical pumping for diode lasers demonstrated to be extra suitable [10-13].

## 3. NUMERICAL SIMULATION (RATE EQUATIONS OF THE MODELING BLUE LASER)

The energy levels in the conduction band and valence band of Quantum well are strongminded by resolving the 1D time independent Schrödinger equation. It's a measured typical which defines the performance of classification as a function of 3-D and time coordinates in standings of a wave function (Ψ). Solving the Schrödinger to get the probable Ψ that can occur within the section [10].

$$-\frac{\hbar^2}{2m}\frac{d^2\psi(x)}{d^2x}+v(x)\psi(x)=E\psi(x) \quad (1)$$

substituting,

$$\psi(x) = \mathrm{Asinkx} + \mathrm{Bcoskx} \quad (2)$$

$$\frac{\hbar^2 k^2}{2m}(\mathrm{Asinkx} + \mathrm{Bcoskx}) \quad (3)$$

this gives

$$E=\frac{\hbar^2 k^2}{2m} \quad (4)$$

Outdoor the well, (x) = 0 and (x) = A sinkx. Hitting x = a, wherever (a) is the width of quantum: -

$$kx = n\pi \quad (5)$$

accordingly, the equivalence develops,

$$E=\frac{\hbar^2\pi^2 n^2}{2ma^2} \quad (6)$$

this calculation bounces the energy levels for changed values of n can be designed as Figure 4:
The Ψ can be plotted by giving,

$$A=\sqrt{\frac{2}{a}} \quad (7)$$

which gives the equation

$$\psi(x)=\sqrt{2/a}\,\sin\left(\frac{\pi n x}{a}\right) \quad (8)$$

Blue laser diodes produce light in the $\lambda$ from 440 to 485 nm. This area of procedure has controlled to submissions in optical information loading and high-determination printing [14, 15].

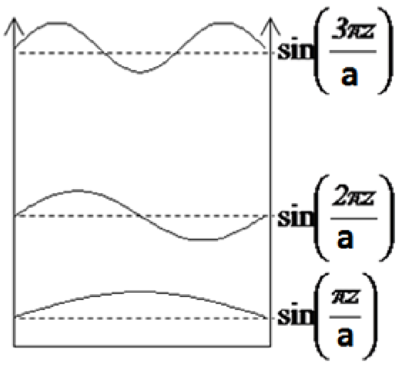


Figure 4. Ψ in quantum well

### 3.1. Materials Used of the Device:

AIN, GaN, InN materials all have a direct band gap.i.e. the optical transition across the band gab are allowed and therefore much strong than in the case of indirect band gaps as shown in Figure 5, for example of SiC [16-19].

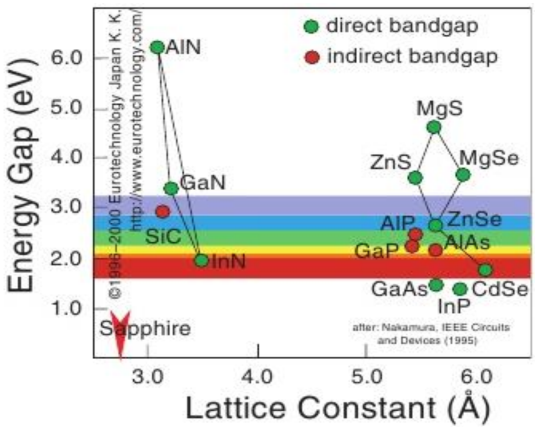


Figure 5. Shows band gap for different materials

Resonant doubling arrangements permit higher efficiencies; 650mW in 430nm has been confirmed [20, 21]. Blue or near UV nitride-based semiconductor laser diodes (LDs) are nowadays commercially available. With regard to their short wavelength, lifetime and low power consumption they became suitable for submissions such as fast laser printing, high density optical information storage and, recently, in pico-size projectors occupied with lasers (400 – 415) nm with a design centered at 408nm per the laser manufacturers' specification, this strategy was improved with a very large and forgiving clear aperture and is as well rewarded for the laser manufacturers' variation thickness [22]. Schematic structure of Nakamura is shown in Figure 6.

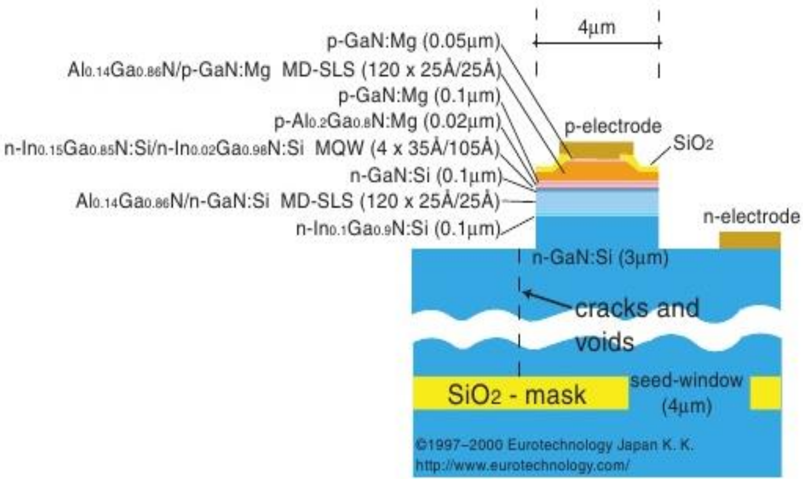


Figure 6. Schematic structure of Nakamura, s blue laser [23]

### 3.2. The Device Structure

The laser diode assembly on a classical substrate as shown in Figure 7, waveguide lasers were invented. Windows associated with the waveguides were imprinted into the SiO2 to contact the p-electrode. An Au bond pad was disappeared on top of the SiO2, contacting the p-electrode [24, 25].

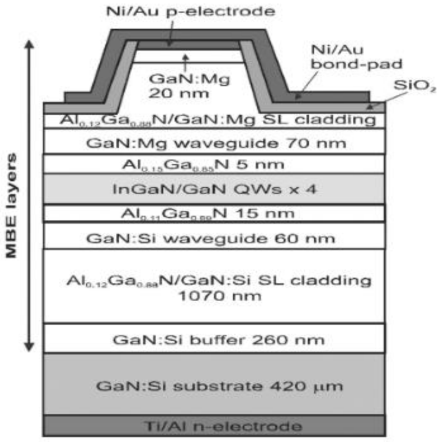


Figure 7. Construction of the InGaN multiple laser diode [26]

### 3.3. State of the Art Performance Level of the Device:

The augmentation takes place in the junction of the semiconductor so only a small part of a small device is involved in the lasing processes. It banquets much less in the plane of the junction than in the plane vertical to the junction. This income that the beam is not $TEM_{0,0}$, the divergence angles are relatively large, on the order of an insufficient degrees, and the divergence angles are changed in the various planes [27-29]. Holes must be measured in the blue laser courses as well as electrons. The active method to variety an optical cavity for producing F.B is to usage reflected surfaces of planes slashed on the crystal [30]. Figure 8. Display the absorption of the key blue laser performance.

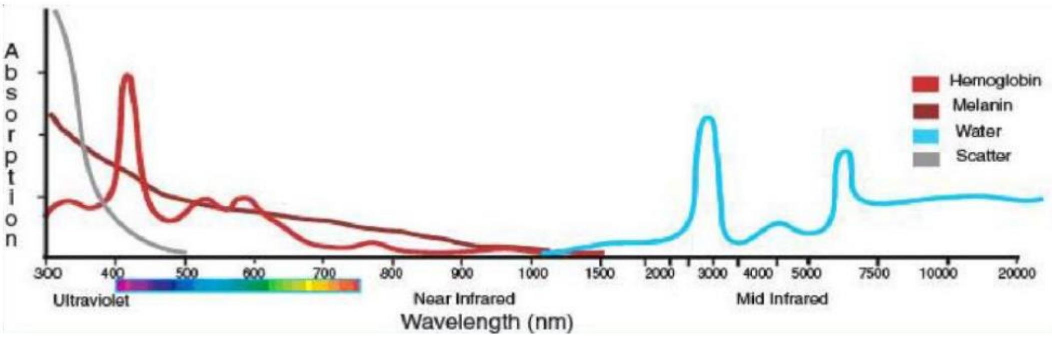


Figure 8. Absorption of the main blue laser performance [30]

### 3.4. The Factor that Limit Performance

The blue laser diode is a relatively recent innovation and did not enter commercial use until 2001. This was due to the difficulty of producing a suitable gain medium and the advances in materials science needed before the technology could become viable. It was primarily the product of research carried out in Poland and Japan, although the blue laser work confirmed the technical problems: -

1. Nonexistence of an appropriate substrate.
2. the disappointment of p-type doping

Scientists at Nichia determined the problematic of the discontinuity in lattice structure at the border molded. Future they enhanced upon the technique by using a buffer layer which is designed by deposit of GaN. The incapacitating was mixed, from Zn to Mg. The secondary blue laser diodes are twenty hundred periods brighter than the former forms [30].

### 3.5. Low Noise

Low noise outcomes from the cavity construction which restricts the number of oscillation methods and maintains exact control of the component temperature. Only high-quality optical mechanisms are used, resulting in a noise specification of < 5.0% rms over a wide operating temperature range [31-34].

A public portion of the amplitude noise is the comparative intensity noise [35]:

$$RIN = \frac{\langle \Delta P^2 \rangle}{\langle P^2 \rangle \approx [2 \times \Delta f S_P(f)]^2 / \langle P^2 \rangle} \quad (9)$$

where Δf is the detection BW, $S_P(f)$ is the spectral density of the power fluctuations, and <P> is the mean P. RIN will reduction with growing pumping rate. If the laser is worked in a multi-mode regime [36, 37]. Specifications of the blue laser and values of parameters can be seen in Table 1.

Table 1. Specifications of the Blue Laser and Values of Parameters

| Parameters | Specifications |
|---|---|
| Power | 100,250 &350 mW |
| λ | 473nm |
| Beam Size | $1.4 \pm 0.2\ mm$ |
| Spacial Mode | $TEM_{00}$ |
| BW | ≤40GHz |
| Divergence | <0.6 m rad |
| Beam Angle | 1 m rad |
| Operation Temp. | $15\text{-}35C^0$ |

## 4. CONCLUSIONS

Blue laser could be advantageous for communication determinations and taking the buildup the advancing. Modules of blue laser can today be designed to fit a broad range of applications [38, 39].

Depending on the required output power, amplitude stability, reliability, frequency tunability, compactness and output wavelength, one can choose between a wide set of laser technology. This study contributes with several new laser setups which can potentially replace much more complex and expensive systems or even enable the realization of new applications. This was possible due to the development of novel laser schemes, mostly utilizing nonlinear optics. The influential beam of blue laser has developed a significant instrument for spectroscopic analysis.

A blue laser system is used for stimulating emission from solid models for spectrographic analysis. Additional quantities have been carried out utilizing like blue laser diodes for underwater data transmission and laser tracing. Researchers need enhanced approaches to accurately make new the blue laser applications to use modern experimental measurements.

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