13th International Conference on
Engineering And Technology
27 December 2019 | Oslo - Norway
ICETCONF

Laser Quantum Simulation by Photonic Crystals

Fariborz Palangi Master of Electrical Engineering (Electronics)

Instructor of Electrical Engineering Faculty of Qasr Shirin Azad University

Email: fariborzpalangii@gmail.com

Abstract:

Photonic nanocrystals structured as quantum boxes, cubes, pyramids, and spheres with dimensions ranging from 1nm to 10nm, using a photonic crystal micro-cavity optimized with a resonance wavelength of 1536 μm and a quadrilateral QD 1431.88 μm laser resonance structure. Photonic crystals with different geometries are considered as a light source for integrated optical, medical, optical communications, telecommunication and industrial circuits for optimum wavelength laser output and low quality output power that is simultaneously stable. It is investigated using finite difference time domain (FDTD) calculations and flat wave propagation. This high-output, low-area, easy-to-design micro-cavities have been studied. The results show that this laser quantum is superior to similar lasers.

Keywords: Laser Quantum, Photonic Crystal, Microwave, Quantum Dots, Resonance, Wavelength.

1. Introduction :

Quantum lasers are an important optical device that has been widely used in recent years, and quantum lasers have three essential components: (a): An active conductor in the form of a rod that can selectively characterize the surface energy population. B) An energy pump to create a population gap between some levels. (C): A resonant cavity that aggregates the emitted waves and maintains the coherence of the emitted waves. [1]

Quantum dot lasers are one of the semiconductor lasers. In fact, quantum dots are electrically excited or fluorescently excited by a wide range of wavelengths at very specific frequencies, thus absorbing the frequency and the specific frequency (which is also a function of their size). They can reflect, fracture or absorb light depending on the applied voltage [2].

The FDTD method is used to determine the time domain distribution of the microcavity state. [3]

In high-quality cavity holes, the reduction of electromagnetic fields in time therefore the quality factor (coefficient) is not obtained directly from the frequency distribution. The extreme FWHM effect is limited by the light distribution time, so the cavity quality is sub-defined. [4]

$Q = \omega r /\ FWHM.$

The full width at half maximum frequency is where the amplitude of the resonance signal is defined by the resonance (resonance) ωr FWHM in the following relation.

$E(t)= e^{-t(\alpha-\omega r)}\ .u\ (t).$

To be. EQ is the signal attenuation constant for the Fourier transform;

$\left| E\ (\omega) \right| = 1\ /\ \alpha^{2} + (\ \omega-\omega r)^{2}.$

Here α is determined by W / 2Q, so the coefficient of α is obtained as the quality coefficient.

To obtain the relationship between the envelope time signal of the quality condition, the time envelope must transform a logarithmic function into a line function. . [5]

$\log 10(\left| E(t) \right|) = [-\omega r\ /2Q]\ .\log 10\ (e) = mt.$

In the case of m the slope of the signal will offset the logarithmic time of the contraction coefficient so the equation of the cavity quality coefficient for the case in SI unit will be calculated as follows.

$Q= -2\ \pi f\ R \log 10\ (e)\ /\ 2m.$

The advantages of laser quantum can be single mode, high output spectrum, high quality modulation speed and these features make this laser used in optical, medical, optical communications and industrial systems.

2- Proposed Structure

In this paper, a two-dimensional microcavity quadrupole crystal with a functional approach to quantum lasers has been studied. . . [6]

With several structural optimizations, the highest output power is obtained for a particular laser quantum, such as the specific wavelength, improving the quality coefficient and the wavelength that are simultaneously stable are the most important features of this structure. And of the semiconductor material is indium phosphide (Inp). [7]

As shown in Fig. 1, the lattice constant of these two loops is 575nm and the outer lattice radius is 196nm and the inner lattice radius is 100mm. The rectangle is shown using the FDTD method.

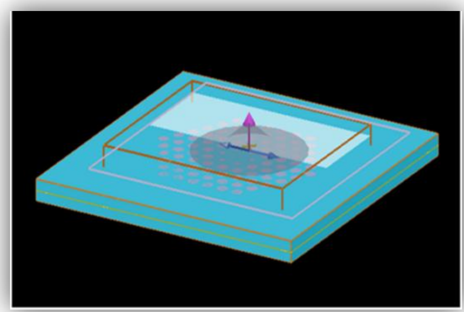

Figure 1 - Designed photonic crystal laser quantum structure

3. Simulation results:

Using the features of the structure, the FDTD software is used in this paper. It solves the Maxwell equations (3D) for quasi-crystal analysis with finite difference time domain and investigates the light emission behavior within these structures. For the distribution and the coefficient of microcavity quality, the field distribution in the Fourier and Time domain is discussed. [8]

The refractive index of the cavity substrate 0995/2 is selected. In the boundary conditions of all simulations, a perfectly matched layer (PML) is assumed. Each step of the simulation is repeated several times to ensure consistency and reproducibility of the final results. . [9]

Using these techniques, the simulation of the prototype structure performed at 1500fs achieved a quality factor of 184 / 799nm at 143 / 88nm by optimizing the parameters of the microcavitation

quality factor and increasing the resonance wavelength to the laser quantum wavelength. The output graphs are shown below. [10]

Figures 2 and 3 to zero the good microcavity resonance to zero to stabilize the more the oscillation behind the field is better, eventually reaching zero EX-EV-EZ These are the same fields in the coordinate direction [11].

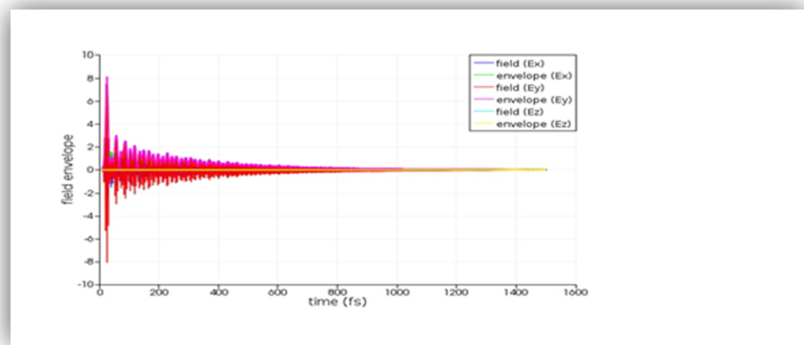

Figure 2. Field distribution diagram

The time-domain field coverage for the intensification of the micro-cavity crystal displays our source monitor coordinates in photon simulation on the X and Y axis. Our Gaussian source with a resonance (resonance wavelength) for a laser of 1433.88 nm enters the photonic crystal laser quantum structure and this is the photonic crystal field diagram. (Red and yellow dots) Depending on the vertical axis

The field value is higher and is between 1.4-4.2 ⁻ 6 tenths per second and the blue areas around the field represent the lowest value in Figure 3. [12]

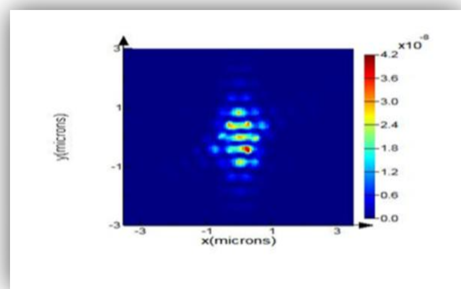

Figure 3 - Time-domain field coverage for photonic crystal microcavity resonance

Hersonance (resonance) must be separated using the Gaussian filter in the frequency domain; an approach of quantum effects on active layers of a multi-structure laser such as gain or optical gain is expected. The effect of QD gain on laser structures based on indium phosphide QD materials has been analyzed. Therefore, with the decrease of the dimensions, the maximum laser quantum gain is significantly increased [13].

The Gaussian Yump pump source is one of the laser quantum components with the maximum inside of the laser being quantized. In our simulation, a Gaussian pump of 107 with a resonance wavelength of 1433.88 is obtained, which shows the equivalent wavelength and frequency relation of 210THZ with the blue graph of the Gaussian filter or pump. And the green diagram shows the peak of the cavitation resonance. Figure 4.

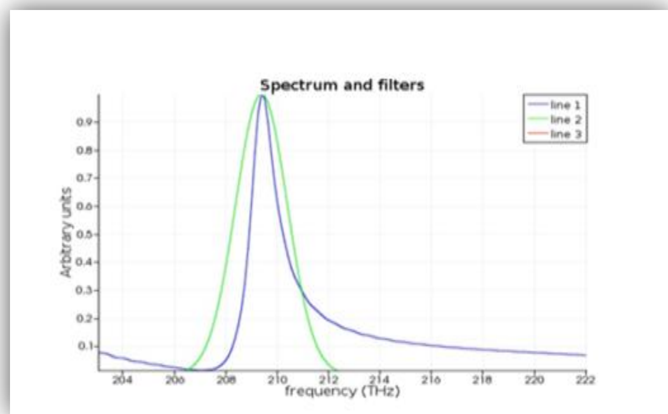

Figure 4 - Resonant peak and the corresponding Gaussian filter in the frequency domain.

A continuous-wave pump was used to simulate a QD-like crystal laser with an operating wavelength of 1431/88nm. A four-dimensional QD model with an indium phosphate (INP-) based structure is placed at the center of the structure first initiating the excitation process then microwaving. Crystals during 1431 / 88nm resonance wave due to QD with maximum refractive index at this wavelength excite logarithmic diagram of laser (input-output) laser and laser output of quasi-crystal quantum dot at 1431 / 88nm operating wavelength It is between 41000w / m2 to 43000w / m2. Be with

E or field fits here The laser quantum output power has a constant and relatively high value, and the power of the laser quantum pump is obtained from the cavitation shown in Fig. 5, which has a high value. This is our designed laser quantum advantage. The article is that there is usually oscillation within other lasers. [14]

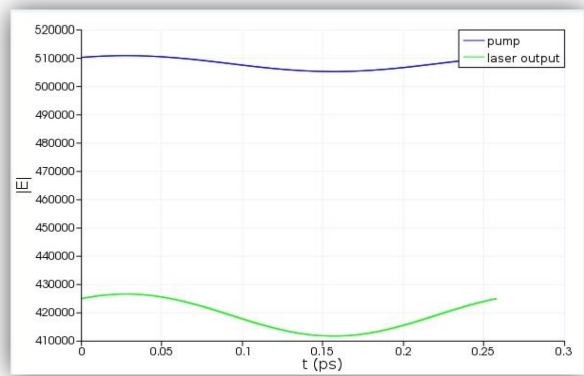

Figure 5 - Pump power and output power of a quasi-crystal quantum laser at 1431/88 nm.

From the optimization approach for the microcavity structure characteristics, the effects of various parameters on the output power optimization have been investigated using a 1431/88 nm quantum dot laser as the optimum structure of this high-output quasi-crystalline microcavity. Electric LaserBlurfotonium and Electric Field Variation over Time As you can see, the laser has a very high peak field electric field, and these are our designed photonic crystalline laser quantum dots. [14]

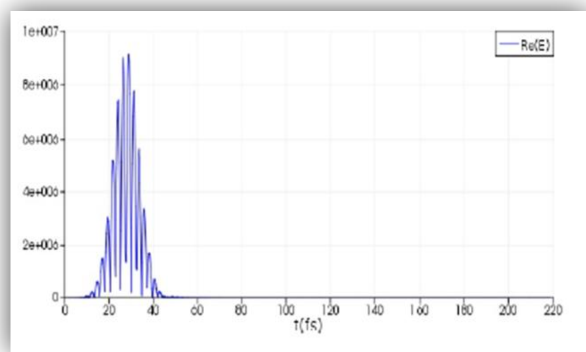

Figure 6. Electric field over time

The electric field spectrum, which is the spectrum of the self-quantum field, whose points are centered in red and yellow, are greater at these intensities. Figure 7

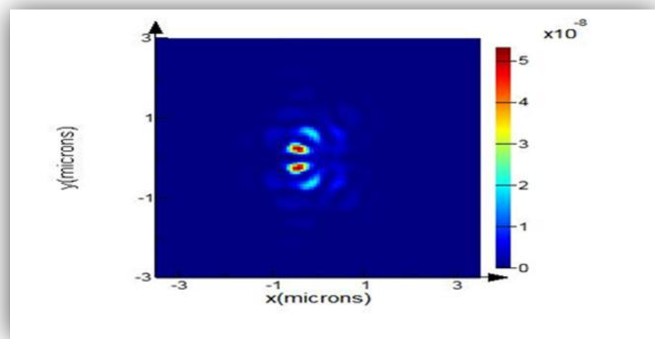

Figure 7 - Field spectrum

Compare with previous articles:

The quantum laser designed in this paper has a higher spectrum than the laser designed by Dr. Bryan et al. In 2010, and the quantum laser designed in this paper has a simpler design than the laser designed by Dr. Jan et al. In addition to the dependence of the emission spectrum of crystalline laser crystals, Our photons are laser. The laser designed in this article has a much simpler design than one of the newer designs, laser powered by Mosley Nezhad 2015, as well as the pump power and output of the quantum crystal photonic laser power designed This article is more. [15-16].

4 - Conclusion:

The best known materials for optical instruments and optical complexes are photonic crystals. [12] The crystallographic instruments are the cavities, and the cavities generate the diffraction waveform of the concentrated dot grid, the electric field spectrum for the quasi-quantum microcavity designed in this paper, and the proximity of the observation point to the cavern to

these points indicates the high field in the equipment. Important features of this designed microwave, high quality coefficient, low conversion rate and long wave

Suitable for quantum lasers, the wavelength of which is the laser wavelength that is utilized by the paper's optimum approach due to its high output power, simplicity of design, low area design in optical, medical, optical communications, telecommunication and industrial circuits. .

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