ISSN 2455-4863 (Online) **www.ijisset.org** *Volume: 6 Issue: 6 | 2020*

Generation Dye Laser Radiation by Semiconductor Diodes

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Abstract: *Dye laser having pumping systems using semiconductor lasers have been considered. The dye after dissolution of CD disk fragments in acetone has been made. For dumping system we use 10 parallel connected semiconductor laser diodes CDs. The carrying out measurements showed that the proposed ourselves construction allows reaching laser radiation power up to 30 Vt.*

Keywords: *laser, dye, acetone, construction, pump, power*

Introduction

The semiconductor lasers occupy a special place between lasers visible and infrared regions ones because of their several characteristics. Semiconductor injected lasers with high efficiencies (close to 100%) for transforming electrical energy to coherent radiation are being characterized and can working in continuous regime. Other practical important features of thus lasers are:

– small inertia dealing with a bride frequencies band for direct modulation (more that 109 Gigahertz);

– simplify of construction;

– there is possibility of rearrangement of radiation wave length λ and presence of many semiconductors for totally overlapping wave length range from 0.32 up to 32 micrometer.

It should be also noted that the semiconductor lasers with best efficiency are being used in cases when coherence and focus requirements are not important but small sizes and high efficiency are necessary. Moreover they exceed than all other types lasers on the energy density and efficiency value. The important quality of semiconductor lasers is possibility of controlling the frequency and light beam that is in them light modulation intensity has time constant $\sim$ 10-11 seconds [1].

Therefore semiconductor lasers for dumping other types lasers are being widely used [2]. For example, in paper [3] to improve the electric discharge semiconductor laser with $A^{II}B^{VI}$ compounds using variable fiber had been proposed.

In paper [4] the scheme of solid disk laser with three zone diode dumping in which all ranges of inverse population of active element are bounded with one beam closed through the flyby cycle resonator and had only output channel from resonator had been investigated. Using special shapes of mirrors with changeable on surface refraction coefficient the generation possibility of high quality radiation with efficiency which not inferring to simple resonators having many modes had been shown.

In paper [5] the comparative analysis of different methods for organizing external optical feedback in semiconductor lasers had been carried out where the schemes with mirror and diffuse attractive objects and polarized elements in external feedback had been considered.

And in paper [6] had been shown that using hyper heat conducting plates together with pulse width algorithm for modulation allows to provide stabilization of ruler substrates temperature of laser diodes with accuracy ±0,1 °C and at the same time to align temperature distribution by its surface with deviation less than 1°C. The laser resonator optical scheme allows to save the radiation angle divergence which exceeds the diffraction limit not more than two times on dumping power up to 100 *Wt*. It had been shown that for increasing light dumping efficiency and laser efficiency in totally is need to use multilayer coatings of broad optical surfaces of slab based on the alternating layers of SiO_2 and ZrO_2.

In the present paper the semiconductor laser for dumping of dye laser has been used.

Experimental Methods

The dye solution in following stages has been made. First we took the clear glass dishes, poured to them acetone, broke case from CD-disc to small pieces and put to acetone. After that when plastic broke up in acetone from case acetone leaked and poured clear one. Further moved well plastic in freshly poured acetone and again leaked it. Such procedure repeated the several times until pure plastic which free from different impurities has been obtained.

Farther we took other transparent case, poured fluorescent red color dye and diluted it in acetone until obtaining dark burgundy color. Solution brought to this state in order to its dark ruby transparency was seen when will visible only in the light. The obtained dye solution by close-knit cotton swab has been filtered. From pre-prepared dissolved plastic acetone totally has been leaked. Instead of that obtained cleared dry has been poured and it very carefully has been mixed. Then dry's leftovers have been leaked and pure dry has been poured again, after thoroughly has been mixed. Such procedure the several times has been repeated and the plastic for the several days in the stationary

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state has been left. After that the plastic has been dipped and became transparent then dry leftovers leaked, contents with the pure dry have been rinsed. Further pure dry once more has been poured and has been left.

Farther we switched to manufacturing shape under the plastic. They brought that moment that the plastic piece was flat cylindrical shape with length 5 centimeter with quadratic size 4×4 millimeter. We poured into the form the dry, washed with one of the form and leaked dry. Once more we poured, after into the form with dry poured already painted plastic. On top of it all we poured dry and closed for evaporating acetone in order to dry did not start falling out and did not litter plastic.

This product for a week has been left. Further not moving a form the pure acetone slowly surged to the form in order to the dry spilled over the edges and there was only pure acetone. The form left open and put to the freezer slowly and with shocks. Upon expiration the acetone evaporated completely and plastic has been withered.

After that we broke the form and cleared obtained working fluid from the form pieces. The working fluid roughness and defects remaining after drying we fixed with selection of the glass pieces, by wetting with acetone and pressing to one the side of working fluid where a defect is presence. We waited until drying out it. We did so with all defects until their completely eliminated and obtained ideal smooth edges and ends without scratches and defects.

When working fluid has been ready then it on the copper metal base has been posted. This base has been covered with glue “Moment” and working fluid stuck carefully to the base. Further from one of the ends side the semiconductor laser pointer has been established. We made sure that the laser pointer shone through the working fluid by length and in output its small spot clearly without any distortion has been saved.

Description of Experiment Elements

In the experiments 10 parallel connected semiconductor laser diodes CdS radiating in wave length 480 nanometers and with the power of each laser equals to 2 Watt. The diode lasers under working fluid along its surface evenly have been posted. The electric scheme has been connected that in order to when it turned on first laser pointer and after diodes have been lighted up. The metal body has made so that all light energy of diodes will attract to the working fluid and can’t go outside. This device has been turned with short pulses not more than one second with pause on 5÷10 seconds.

Measurement of the Radiation Power

The power of the laser radiation we have measured by two ways. By first way the ponderomoter method has been used. Because of the experiment conditions for measuring by this way not allow define more accuracy the power values dealing with the short pulses and pauses for testing experimental results we have add also elements for measuring by second method that is calorimetric one. For that the exit radiation to the calorimeter with distilled water with thermometer has been directed. In order to avoid exit of radiation from the calorimeter its internal side with aluminum foil has been covered.

Believing that the practically all radiation energy transforms to heat we has defined power of exiting laser radiation, P by values of water temperature changes, Δt and delay times, τ

$$P\tau = (c_w m_w + c_{\mathrm{Al}} m_{\mathrm{Al}})\Delta t\,,$$

where c_w and c_{Al} are the specific heats of water and aluminum foil, simultaneously, m_w is the water and m_{Al} is the aluminum foil masses accordingly.

Experimental Results

As experimental results showed that the both ways give practically comparable and indistinguishable values for obtained dye laser radiation power. The dependence of the radiation power on exit on the number of connected diodes in Figure 1 has been presented. It is seen from one that the proposed experimental device allows to obtain dye laser radiation with the power up to 30 Watt.

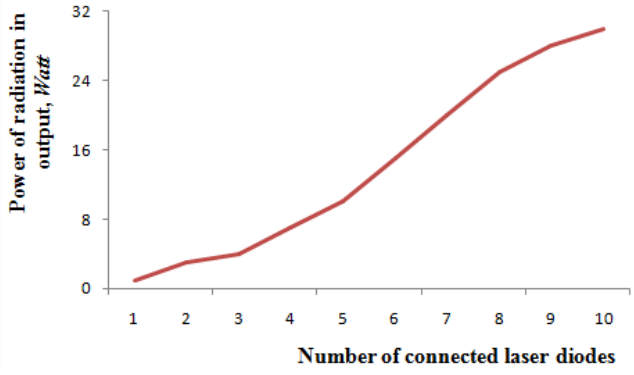

Figure 1: the dependence of radiation power in exit on the number of connected laser diodes

Conclusions

Thus, it follows from carrying out experiments that practically in home conditions we can obtain dye laser radiation with power approximately up to 30 Watt which is dumping by semiconductor laser diodes. This case also in industry may be used.

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