

Intense Pulsed Light object processing in compliance with a data forming method

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데이터 포밍방식에 의한 *Intense Pulsed Light*의 객체처리

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〈Abstract〉

It establishes the nonlinear optics material recently on solid-state laser output side and from the infrared ray until is early has in the ultraviolet rays and the wavelength of broadband there makes be a possibility of getting the laser light which and in processing and measuring field it is widely used. Consequently, it used the pulse reiteration law from origination and nine as the fundamental wave direct plan it produced. intense it affixed the nonlinear optics material (KTP) in pulsed light and it got the green light. When inflicting a same energy in respectively reiteration mesh, intense interrelation of pulse light output and green light output between. It analyzed the conversion ratio which it follows in the mesh.

Key Words : Data forming, Intense pulsed light, Object, Pps

I . INTRODUCTION

The xenon and the krypton are used widely from the solid-state laser flash light ramp[1-4]. The xenon shows relatively high whole electric conversion efficiency from the visible ray or these days outer line[5]. The good defense company of the krypton includes IPL, it agrees to the absorption line of the solid material more well. Consequently, the krypton ramp when the Laser medium which agrees with the

good defense company spectrum of the ramp well here making, is used in pulse application of the low-end power density whose like this good defense company is dominative[6]. But, from the ramp of 3~4mm caliber the xenon is efficient from flash light ramp current density above about 4000~5000A/cm² [7-9]. The reason the plasma operates like the black body emitter and it is because the line structure being suppressed[10]. 4mm bore Xe and the pack which 3mm bore krypton ramps is comparative sprout it shows from the current density which is various.

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$$T = \sqrt[6]{(9450D^{0.03} * J^{0.01})^6 + (93D^{0.27} * J^{0.34})^6} \dots\dots\dots (1)$$

Unit of the J A/cm², unit the meter and the T are absolute temperature from here[9]. In compliance with the plasma temperature which is fixed in order to maintain the spectrum output which is fixed it stands the current density which is necessary there is a necessity the fact that according to increase Sikkim it decreases a caliber. Like it is visible in (2) and the change diameter DR must be used in about the ramp of small caliber.

$$D_R = \frac{D}{1 + \frac{0.0008}{D}} \dots\dots\dots (2)$$

On the effective black body temperature outside also the emissivity of plasma also is very important in plan of Laser system. Plasma emissivity not only wavelength it is a function of caliber and current density. The emissivity increases generally monotonously in about increase of wavelength, it follows 3.

$$E_\lambda = 1 - \exp(-\alpha_\lambda \tau) \dots\dots\dots (3)$$

The ramp of most - there is to plan of the reflector and the desirable thing the ramp radiation which is effective description below in order to reach the top price, a reflexivity from the wavelength unit which the maximum decision absorption for happens with the maximum. For example from the ramp of 3~4mm caliber Nd: YAG systems woman geometry the case and most current density are 4000~5000A/cm²[7]. These people from a or higher current density the emissivity between 700~900nm becomes nearly in 1. To about the

caliber which is a schedule the part which black system curve is more the optimum than proportionally from low-end current density Nd: With YAG absorption bands it makes repeat. But this is offset in order for the plasma emissivity between 700~900nm to be low. From the current density which is higher optimum than most the confrontation of black-body radiation moves with the short wave market piece and it goes and the efficiency falls more quickly in order for the emissivity from these short wave market to increase. This was emitted brings about the loss of energy with the thorn storehouse or UV storehouse. The Laser output pulse of the but high peek is demanded and at the time of quality is like this and the efficiency which decreases often must willingly submit.

Until now discussion it did not consider the problem points which come from the change which is a time of the temperature China output spectrum with radius direction of plasma temperature. When the tube wall condition is retina external, the flash light ramp usual like the ostensible emitter which is uniform and is conduct grudge. The plasma uniformly but very from low-end energy input, it cannot fill a retrocedence. Because of this the problem of image from the reflector, it becomes. The flash light ramp undergarment current-pulse density increases gradually according to atomic beam radiation initially, it starts. Plasma heating according to, the black-body radiation clearly, it becomes. Similar, when plasma it is cool and the black-body radiation remains until last and to make be it becomes. Fig 2-3 is the whole spectrum which is integrated in about the former pulse. The short pulse (10μs or below that) the black-body radiation tail part from the pulse flash light ramp

storehouse is very clear from application. Also with him from the same short pulse electric energy the many part is consumed in heating the ramp wall efficiency to make fall, it becomes. But from solid-state laser system solid wave secret intention storage time because long with him the same short pulse does not meet rarely.

II. EMBODIMENT

When the optical pumping becomes accomplished and to the resonance cabin the population inversion increases and in compliance with these people in order to participate the photons which are a spontaneous emission which occurs to an induced emission process to compose the resonator with two reflectors, the abridged general view being indolent in the picture. In compliance with IPL the light which is emitted various the fire tube includes the frequency which is discontinuous and mode of the resonators and it becomes. If with longitudinal mode where the mode of the resonator takeoff frequency is different generally each other hand weaving is and with it gets divided with transverse mode where the energy distribution is different. Like this modes a respectively with line width, coherence length, beam divergence and beam spot size of beam and energy distribution decide same spatial feature. The resonator according to radius of curvature of the reflector is classified with stable · unstable resonators and the condition of the stable resonator with after words is same.

$$\left[1 - \left(\frac{d}{R_1}\right)\right] \left[1 - \left(\frac{d}{R_2}\right)\right] < 1 \dots\dots\dots (4)$$

Here stands the D to be distance of the resonator and R1 and R2 is radius of curvature of each reflector. Also from the case beam wasit where the beam will depart in TEM00 modes as the Z radius of beam of the place which falls (beam spot size) comes the radius of curvature with after words is same.

$$w_{(z)}^2 = w_{(0)}^2 \left[1 + \left(\frac{\lambda z}{\pi w_{(0)}^2}\right)^2\right] \dots\dots\dots (5)$$

This time beam was it w0 exists in plane and ten-million billion R1 there is in order to do a diffraction loss small radius of curvature R2 it sees the distance D of the general resonator it does small to a fact. Pulse there is a possibility of accomplishing the population inversion of IPL media with the optical pumping in compliance with flash etc. from forming network this time in order to supply an energy in the pumping illuminant must compose pulse forming network where it becomes accomplished resistance (R), the which plaque hour it shakes off big (C), inductance (L) with. Flash etc. single as multiple mesh network it is operated or and these people network to charge and discharge energy when sending to flash etc., current pulse to want in order to have. Is not appropriate the backward flow makes flow case flash etc. the discharge will happen and the life of flash etc. comes to be short and discharge efficiency decreases the current-pulse which flows flash etc. in order for certainly to become critical damping. critical in order to find out damping conditions there is a possibility of seeking that condition at the spring to analyze a circuit equation. And voltage of flash etc. from high electric current territory - the electric current quality with after words is same.

$$V = \pm K_0 \sqrt{|i|} \dots\dots\dots (6)$$

$$K_0 = \frac{KI}{d[\Omega - \sqrt{A}]} \dots\dots\dots (7)$$

Here stand the L, the D and the K respectively show the variable which is related in flashlamp for a long time, flashlamp diameter and gas type and pressure. The nonlinear differential equation with after words is same in about circuit.

$$\frac{dI}{dr} + [\alpha + \beta \sqrt{|I|}] \sqrt{|IRIGHT|} + \int_0^r I dr = 1 \dots\dots\dots (8)$$

here $I = i \sqrt{\frac{LC}{V_0}}$
 $r = \frac{t}{\sqrt{LC}} \dots\dots\dots (9)$

$$\alpha = \frac{K}{\sqrt{V_0 Z_0}} \dots\dots\dots (10)$$

$$\beta = r \sqrt{LC} \dots\dots\dots (11)$$

$$Z_0 = \sqrt{LC} \dots\dots\dots (12)$$

The R is total resistance of the circuit which excepts oneself resistance of flash etc. and the alpha is damping parameter where it shows the discharge quality of flash etc. When resistance of circuit very being low, namely the case which is pulse forming network where it is produced well (the discharge quality of $\beta \approx 0$) flash etc. is decided and the C which plaque hour it shakes off big and input voltage V0, in compliance with an inductance L that after being cool with, it is same.

$$C^3 = 0.09 \frac{E_0 t_p^2}{K_0^4} \dots\dots\dots (13)$$

$$L = \frac{t_p^2}{9C} \dots\dots\dots (14)$$

$$E_0 = \frac{1}{2} CV_0^2 \dots\dots\dots (15)$$

$$Z_0 = \sqrt{LC} \dots\dots\dots (16)$$

$$\alpha = \frac{K}{\sqrt{V_0 Z_0}} \dots\dots\dots (17)$$

Upper it will be cool and it uses and the L and the C and a possibility of getting the pulse there is. shape it decides Like this pulse shape with discharge of flash etc. will have a big connection and various diminution variable (damping parameter) it will illustrate at the time of $\alpha=0.75$ day the flash etc. discharge current damping critical at about time, in the picture, the possibility which it will know it was. This time critical damping meaning at instantaneously short time it emits the many light it is a thing.

PFN in compliance with the characteristic impedance of circuit watch from circuit it showed the approximate equation of the complex style circuit which is decided.

$$Z_n = \sqrt{\frac{L_T}{C_T}} \dots\dots\dots (18)$$

$$t_p = 2 \cdot \sqrt{\frac{L_T}{C_T}} \dots\dots\dots (19)$$

$$C_p = \frac{t_p}{2 \cdot Z_n} \dots\dots\dots (20)$$

$$L_p = \frac{t_p \cdot Z_n}{2} \dots\dots\dots (21)$$

$$V = \sqrt{\frac{2 \cdot E}{C_T}} \dots\dots\dots (22)$$

$$i_p = \frac{V_0}{2 \cdot Z_n} \dots\dots\dots (23)$$

Only,
 Zn: Characteristic impedance of circuit watch [Ω]

- LT: Total inductance of many item mesh [μH]
- CT: The gun of the many item mesh the plaque hour it shakes off big [μF]
- tp: Current-pulse width [S]
- V0: Charging voltage [V]
- E: Flash light ramp input energy [J]
- IP: The maximum electric current which flows in the flash lamp [A]

input energy $E=100\text{J}$ from experiment, changes the authorization method of input energy and to compare the current-pulse wave shapes of the flash light ramp drive circuit which it observes. The wave shape A price a week circuit C1~C6 and with public affairs $80\mu\text{F}$ F all it input 100J input energy in here, the reiteration circuit did not operate, it does not correspond in case. Wave shape B C1~C6 price of week circuit all $80\mu\text{F}$, C1~C3 price of reiteration circuit after one, to week circuit 75], to reiteration circuit is the current-pulse wave shape of the case which authorizes 25J input energy respectively with all $40\mu\text{F}$ It changes the delay time t_d of the reiteration wave shape. it shows the electric current wave shape which is representative it observes, to make The pulse electric current wave shape A, the B and the C delay time t_d respectively shows the case which is $0\mu\text{s}$, $150\mu\text{s}$ and $250\mu\text{s}$. From input energy $E=100\text{J}$ delay time t_d of the reiteration wave shape it changes from within $0\sim 1\text{ms}$ scopes. Laser which it measures an output energy being empty, it shows, to make It does not use a reiteration from the picture many case which authorizes 100J input energy in only all week circuit, ipl being empty, output energy were about 735mJ , two pulses it repeated and the delay time $0\mu\text{s}$ day case, Laser being empty, energy output energy was about 765mJ . When with the case which does not use a reiteration it compared, the output and efficient improvement of the maximum 4.5% came to get from delay time $0\mu\text{s}$. Like this the result originates to ipl physical properties qualities. ipl spontaneous emission life time t_f of the case where the delay time t_d of $230\mu\text{s}$ is reiteration wave shapes is smaller about $230\mu\text{s}$ than, with the week pulse in compliance with the reiteration pulse with the fact that first the atom which has become here in

III. IPL OUTPUT QUALITIES



Fig 1. Experiment equipment

which it follows at delay time t_d the power supply unit simmer circuit the xenon (preparation lighting description below for Xe) flash light ramps on a large scale, simmer starter and charging power supply, controls the delay time of the reiteration circuit which is composed of the week circuits which are composed of 6 only mesh circuit watches and 3 only mesh circuit watches and the reiteration pulse the circle shot for the distant mote at is composed of the pulse reiteration control circuit where is composed with the [thu] with free self-control. The case which will authorize an

junior warrant officer high position contributes in all Laser output. But, the case where the delay time t_d will be bigger $230\mu s$ than, in compliance with the reiteration pulse in compliance with the week pulse in compliance with a spontaneous emission with after that first the atoms which had become here in junior warrant officer high position elapse spontaneous emission life time t_f if it makes junior warrant officer fall subordinate position on the middle where the atoms become here with junior warrant officer high position. Consequently, the case where the delay time t_d is bigger spontaneous emission life time t_f than it accompanies a fluorescent loss Laser being empty, the output energy is visible the tendency which it decreases rather. ipl, the pulse electric current wave shape and Laser output of the case where the delay time t_d of the reiteration wave shape where outputs become the maximum is $0\mu s$ being empty, it corresponds to the profile. A wave shape, the pulse electric current wave shape and the B Laser output being empty, show the profiles and TH (Threshold) reversal distribution formation kind takeoff start points from the picture. From wave shape A QTH does not contribute the loss part and, QL becomes the part which it contributes in Laser output in ipl outputs. Recording QTH where the rise time will be quick consequently comes to be small, QL becomes larger relatively and the Laser output comes to be high, recording which will be near in sine group, the recording output whose peek will be big is high

IV. EXPERIMENTAL RESULT

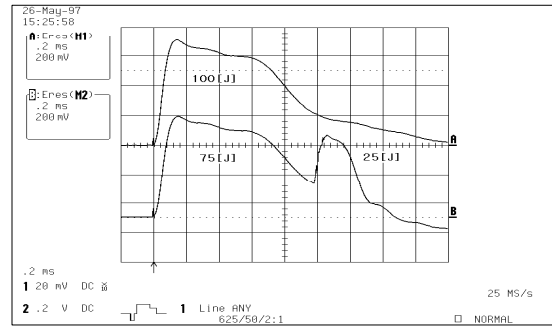


Fig 2. The comparison of current waveforms according to the applied method of input energy E

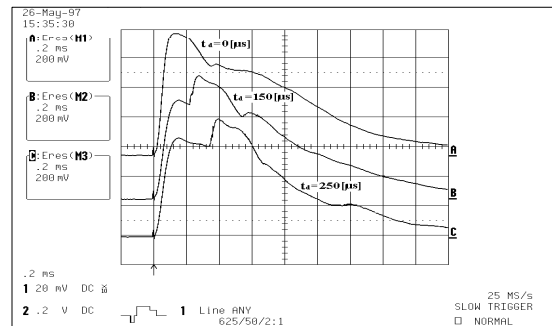


Fig 3. Current waveforms according to the different delay time

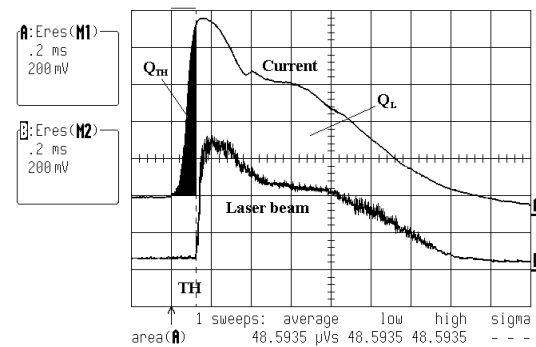


Fig 4. Laser output according to the values of the different delay time t_d at $E=100J$

Table 1. Current waveform and Laser beam profile at 0 μ s of the delay time

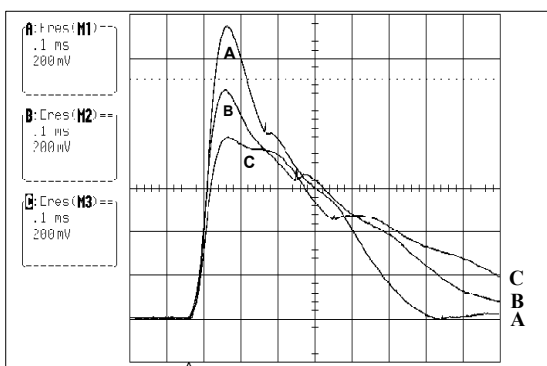
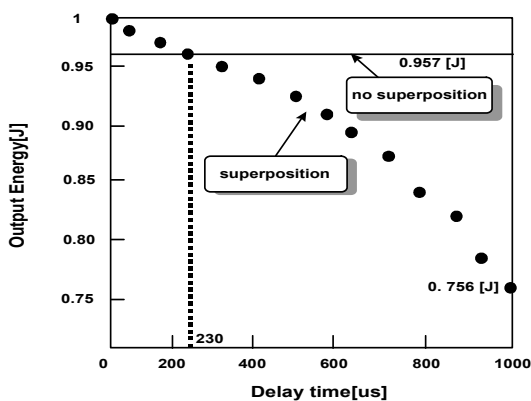


Fig 5. Current waveforms according to the number of meshes

Fig 2 The comparison of current waveforms according to the applied method of input energy E. Fig 3 Current waveforms according to the different delay time. Fig 4 Laser output according to the values of the different delay time t_d at $E=100J$. Table 1 Current waveform AND Laser beam profile at 0 μ s of the delay time. Fig 5 Current waveforms according to the number of meshes. It shows the electric current wave shape of the flash light ramp which from delay time 0 μ s it follows in each mesh. Wave shape The week pulse 6 only mesh and the reiteration pulse 3

only mesh and wave shape B the week pulse 4 only mesh and the reiteration pulse 2 only mesh and wave shape C the week pulse are the electric current wave shape of 3 only mesh and the case which composes the reiteration pulse with 1 only mesh. The wave shape A rise time is quick, peak grows most. The Laser output grows consequently most. It shows the Laser output which it follows mesh possibility. The case which authorizes an input energy 50J, when repeating 1 grade 3 grades, the biggest output (960m) the possibility of getting it was.

1064 [after the infrared laser output which has nm] wavelength passes KTP 532 [there is a possibility the fact that it converts in the green illuminant which has nm] wavelength. To week circuit 3 only, 4 only, 6 it composed the mesh only and to reiteration circuit 1 only, 2 only, 3 only it composed the mesh. Namely 3 only - 1 only, 4 only - 2 only, 6 only - 1064 where it comes out authorizing a respectively same energy to the pulse reiteration circuit which has 3 grades [nm] ipl outputs and 532 [conversion efficiency it measured the energy which comes out being converted with nm] green storehouse respectively and it bought. To week circuit 3 only, to reiteration circuit 1 it composed the mesh only and input energy 30J, 40J, 50J and 60J, when authorizing 70J respectively, it measured the kind green broad output which transmits ipl output which comes out and a nonlinear optics decision. There is a possibility the fact that the recording green storehouse conversion efficiency where the input energy will increase decreases. To week circuit 4 only, to reiteration circuit 2 it composed

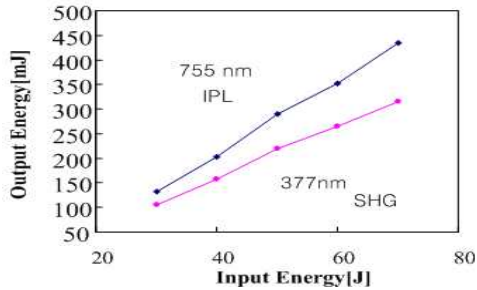


Fig 6. Output of wavelength (377nm)

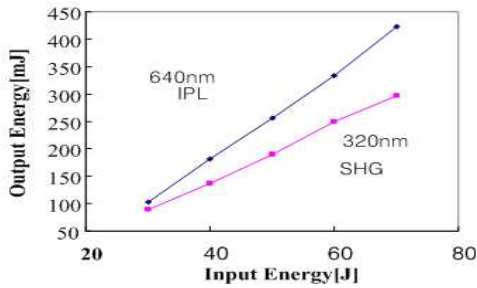


Fig 7. Output of wavelength (322nm)

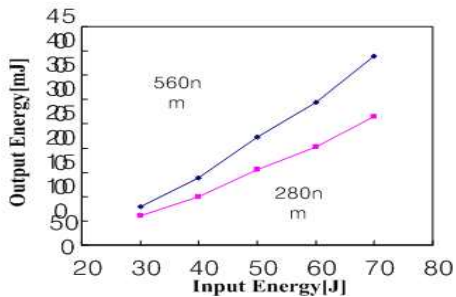


Fig 8. Output of wavelength (280nm)

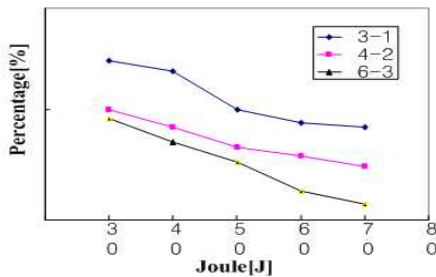


Fig 9. Output of energy

the mesh only and the variable it made it went and when authorizing, ipl output and a green storehouse output and a respectively conversion quality indolently it measured it put out an input energy respectively. There is a possibility the fact that the efficiency which it converts with the recording green storehouse where the input energy will increase decreases. Fig 6 shows shgoutput of wavelength (377nm) where it applies SHG. Fig 7 shows output of wavelength (322nm) where it applies SHG. Fig 8 shows output of wavelength (280nm) where it applies SHG. Fig 9 shows output of energy comparisons which apply SHG. To circuit 6 only, to reiteration circuit 3 it composes the mesh only and the variable it makes it goes and when authorizing, a Laser output and a green storehouse output and a possibility the fact that the efficiency which it converts with the recording green storehouse where the input energy will increase decreases it measures respectively conversion quality there is an input energy respectively. It shows green broad conversion efficiency. 3 only - the green storehouse all output where the case of 1 grade leads the fundamental waves and SHG elements came to get most highly.

V. CONCLUSION

It composed the pulse style ipl which and it plans in many item mesh circuit watch method the pulse formation technique it will be able to control the shape of current-pulse forms and ipl light pulses of the flash light ramp it developed. Also cross check the output which it follows in ipl output which it follows in delay time evolution of the reiteration pulse and mesh

possibility change. And ipl being empty, SHG converters transmission possibility it will stand and a same conclusion and with after words the result which buys the input-output quality to measure the output of the green illuminant which comes out it will get it made. The delay time of (1) reiteration pulses shows 0 μ s day case maximum output power, it compares it is visible in the nothing insect concubine and 4. 5% efficient improvement. (2) sine group is, spherical shape group is the rise time to be quick, recording whose peek will be big, recording whose and pulse width will be narrow it is visible a high output. 3 the possibility the green storehouse output knowing about 10~30% loft inesses from the input energy which is the same case where only - the case of 1 grade is different than in about (3) many item mesh reiteration circuits. (4), about 0.5% the possibility the fact that it decreases there was efficiency which it converts with the recording green storehouse where input energy will increase.

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