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FLASHLAMP PUMPED NARROW LINEWIDTH DUAL-WAVELENGTH Ti:SAPPHIRE LASER

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INTRODUCTION

Flashlamp pumped tunable solid-state lasers have many advantages, for example, easy to scale-up the output energy, compactness in the system and easy to maintein. Taking those advantages, increase of their functions as a powerful tunable laser is of interest. In this paper, an dual-wavelength operation of a flashlamp pumped Ti:Sapphire laser with a modified grazing-incidence grating resonator is presented. And also, a simultaneous second harmonic generation (SHG) of the dual-wavelength outputs with a single non-linear cystal (BBO) is demonstrated, which expand the wavelength range of dual-wavelength laser developed.

DUAL-WAVELENGTH OPERATION

Narrow linewidth, single wavelength operation of a flashlamp pumped Ti:Sapphire laser with a grazing-incidence grating resonator was described elsewhere[1]. A simple modification of this resonator allows simultaneous, independent two wavelengths operation. A tuning mirror was cut into two pieces and independently adjusted to reflect back the first order diffraction of each wavelength (Fig.1).

In this configuration, each beam occupies an independent volume in the Ti:Sapphire crystal. Therefore, free selection of two independent wavelength is possible with ignoring the difference of the stimulated emission cross-section and without competition between two wavelengths. An energy distribution between two wavelengths is also controllable by adjusting the position of the tuning mirrors.

Fig.2 shows an example of the dual-wavelength laser sepectrum measured with a spectrometer and an optical multi-channel analyzer (OMA). The shot-by-shot spectrum was quite stable, which results from the nature of the resonator.

The sum output energy for the dual-wavelength operation at 800 and 850 nm is ~88 mJ, while in the single wavelength operation the output energies are 57 and 53 mJ for 800 and 850 nm respectively. Therefore, the total output energy at the dual-wavelength operation is ~80% of the sum of energies obtained in the single wavelength operation. This is due to the diffracted light at the edges of the tuning mirror.

In order to examine that two laser beams separately oscillate in the resonator, the spectrum distributions in the laser beam cross-section were measured at the near field. A pinhole (ϕ=0.3 mm) was placed 12 cm apart from the grating center and scanned along the center line of the beam cross-section at every 0.5 mm. A lens was inserted in front of OMA so that the laser hits the same point on the diffuser during the pinhole scan. Fig.3 shows a result at the dual-wavelength operation (800, 840 nm). This proves the separation of the beam except a small component diffusing into the neighboring volume which may be caused by the diffraction at the mirror edge. The wavelength combination may be limited by this diffracted light.

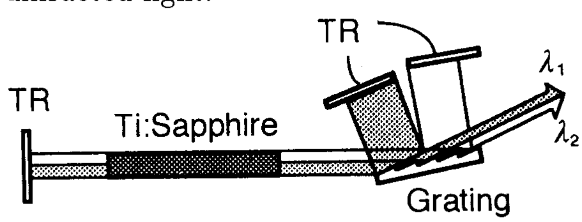

Figure 1: Dual-wavelength grazing-incidence grating resonator. The grating is holographic, 1800 grooves/mm with a gold coating on the surface. (TR : flat total reflector @670~950 nm)

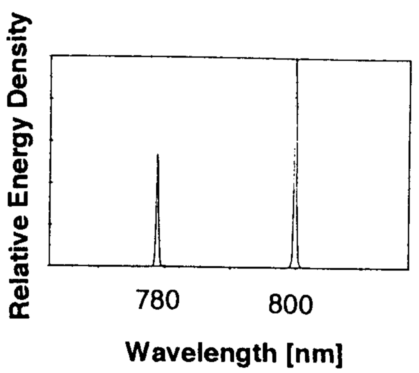

Figure 2: The laser spectrum for dual-wavelength operation.

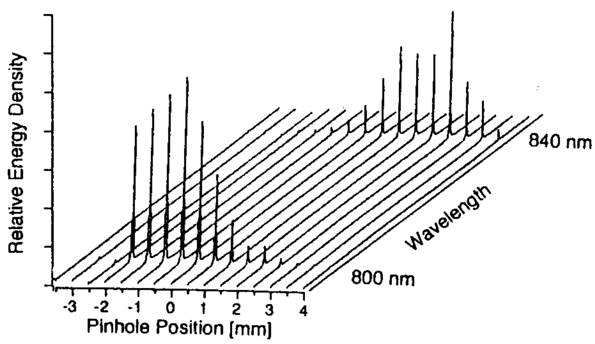

Figure 3: Typical laser spectrum distribution in space measured by scanning a pinhole obtained at dual-wavelength operation.

SIMULTANEOUS SECOND HARMONIC GENERATION

The second harmonics (SHs) of the dual-wavelength laser were obtain using the optics shown in Fig.4 simultaneously. This is a modified version of a design developed for a single SHG of tunable laser without any adjustment[2, 3]. In this arrangement, once adjusted, one can obtain SHs of the dual-wavelength laser at any wavelength combi-

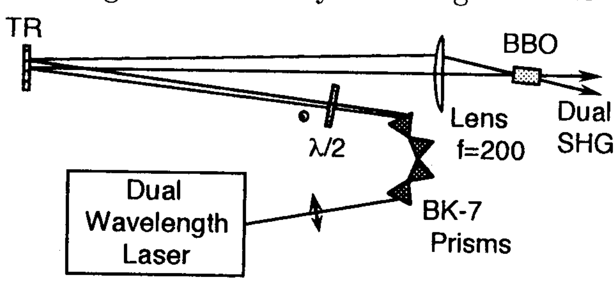

Figure 4: Experimental setup for dual-wavelength simultaneous second harmonic generation.

nation. Four BK-7 60° prisms give angle to each beam and focusing lens (f=200 mm) gives an additional angle by factor of ~10 to produce the proper phase-matching angle of the SHG crystal (30°-cut, 4×4×7 mm, type-I β-BaB_2O_4).

Simultaneous SHG was observed in the spectrum ranging from 390 to 420 nm. Since adjustment of the optics was carried out with 800 and 840 nm of the fundamental laser, it may not be optimized completely out of this range. For longer wavelength side, spectrum range was limited by the resonator geometory in our experiment.

REFERENCES

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