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マイクロチップレーザーによる尖頭出力＞3MW 波長 355nm 光発生

> 3 MW Peak Power at 355 nm Using Microchip Laser

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Passively Q-switched microchip lasers have several advantages, such as, simple construction, compact size and ease-of -use. They also provide very high peak powers, as they operate in the subnanosecond "pulse-gap" region [1], which enables efficient wavelength conversion. Recently, we have used Nd:YAG/Cr^{4+}:YAG passively Q-switched microchip lasers to obtain very efficient second harmonic generation (SHG) [2], and fourth harmonic generation (FHG) [3].

However, for several applications, third harmonic generation (THG) is desirable. Here, we report the results of efficient THG using a passively Q-switched microchip laser.

The experimental set-up is shown in Fig. 1. The microchip laser uses a [110]-cut Cr^{4+}:YAG to passively Q-switch a Nd:YAG laser. The details of the laser are similar to those described in [2]. We obtained a laser output of 3 mJ pulse energy, 345 ps pulse width, 100 Hz repetition rate at 1064 nm. This gives a peak power of 8.7 MW.

We used a 10 mm-long Type I LBO crystal in the critical phase matching (CPM) regime for SHG. Thanks to the high fundamental peak power, we did not use any optics between the laser and the LBO crystal to focus the input beam. By angle-tuning the LBO crystal, we obtained an output of 1.15 mJ pulse energy, 230 ps pulse width, 100 Hz repetition rate at 532 nm. This gives a peak power of 5 MW and a conversion efficiency of 57%. It is possible to achieve higher conversion efficiency by focusing the input beam into the LBO crystal. However, this is not required since we wish to perform sum frequency generation (SFG), in the next step, to achieve THG.

For THG, we used a 10 mm-long Type II LBO crystal in the CPM regime. Again, no optics was used between the two LBO crystals. It was found necessary to slightly retune the first LBO crystal (for SHG), in order to maximize the THG output.

After proper retuning the first LBO crystal, we obtained an output of 0.65 mJ pulse energy, 170 ps pulse width, 100 Hz repetition rate at 355 nm. This gives a peak power of 3.8 MW and a conversion efficiency of 76% from 532 nm to 355 nm. The conversion efficiency from 1064 nm to 355 nm is 44%. We believe that this is the highest THG efficiency achieved using microchip lasers.

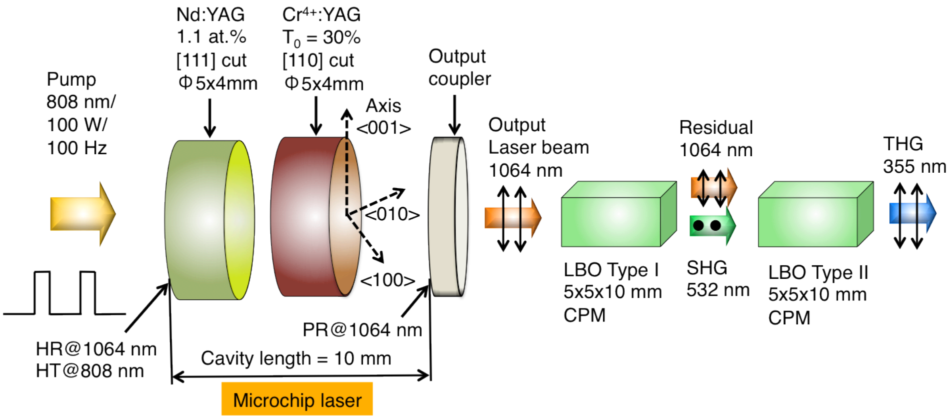

Fig. 1. Experimental set-up for THG.

References:

[1] T. Taira, "Domain-controlled laser ceramics toward giant micro-photonics [invited]," Opt. Mater. Express **1**, 1040-1050 (2011).

[2] R. Bhandari and T. Taira, "> 6 MW output power at 532 nm from passively Q-switched Nd:YAG/ Cr^{4+}:YAG microchip laser," Opt. Express **19**, pp. 19135–19141 (2011).

[3] R. Bhandari and T. Taira, "Megawatt level UV output from [110] Cr^{4+}:YAG passively Q-switched microchip laser," Opt. Express **19**, pp. 22510–22514 (2011 NLO Focus Issue).