17p-E18-6

[100]Nd:YAG 結晶による複合 YAG/Nd:YAG レーザーにおける熱複屈折誘起デポラリゼーションの低減

Reduction of Depolarization Loss in Composite YAG / Nd:YAG Lasers by Use of [100]-Cut Nd:YAG Crystal

分子科学研究所　°バンダリ　ラケシュ，平等　拓範

Institute for Molecular Science　°Rakesh Bhandari, Takunori Taira

E-mail: bhandari@ims.ac.jp

Depolarization occurs in the normally used [111]-cut Nd:YAG crystal due to thermal birefringence. Several methods, such as the use of two crystals with a 90° quartz rotator between them, have been be used to compensate for the thermally induced birefringence [1]. However, this makes the system quite elaborate.

Shoji and Taira [2] suggested a simple way to intrinsically reduce the depolarization by the use of [110]-cut or [100]-cut Nd:YAG, instead of the [111]-cut crystal. Tunnermann et. al. verified this experimentally and showed that for a few hundred watts pump power, [100]-cut Nd:YAG is most effective [3].

We have been working on high pulse energy microchip oscillators for efficient wavelength conversion using the sub-nanosecond pulse width region [4]. At high repetition rates, thermal lensing limits the beam quality of the microchip oscillator. To solve this problem, we have used an undoped YAG end cap on the doped Nd:YAG crystal. This reduces thermal lensing, but causes depolarization due to local thermal stress produced at the interface between the end- cap and the doped Nd:YAG crystal.

To reduce the depolarization, we used [100]-cut Nd:YAG, instead of [111]-cut Nd:YAG, in our passively Q-switched microchip oscillator shown in Fig. 1. Figure 2 shows the depolarization ratio of the output, as a function of the repetition rate for an output pulse energy of 1.42 mJ at 1 kHz. At 1 kHz, the depolarization with [100]-cut Nd:YAG is reduced to1/5 of the depolarization obtained with [111]-cut Nd:YAG.

We performed second harmonic generation (SHG), using a 10 mm-long LBO crystal. For a 1064 nm input of 1.42 mJ pulse energy, 600 ps pulse width at 1 kHz, we obtained 462 μJ pulse energy with a pulse width of 420 ps giving a peak power of 1.1 MW at 532 nm. The conversion efficiency was 46% approx.

Our results will be very useful for designing compact green and UV microlasers.

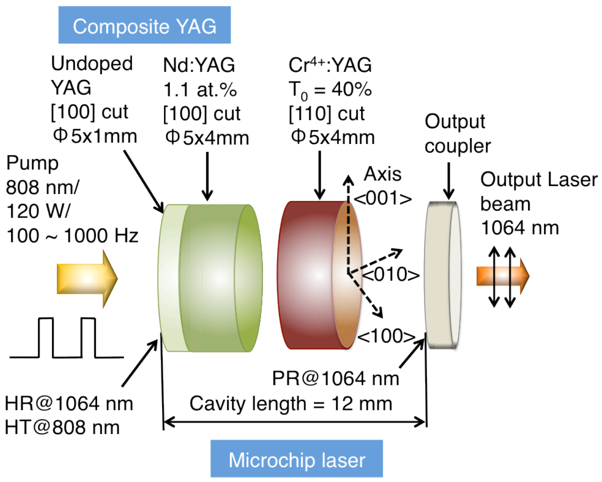

Fig. 1. Microchip laser structure.

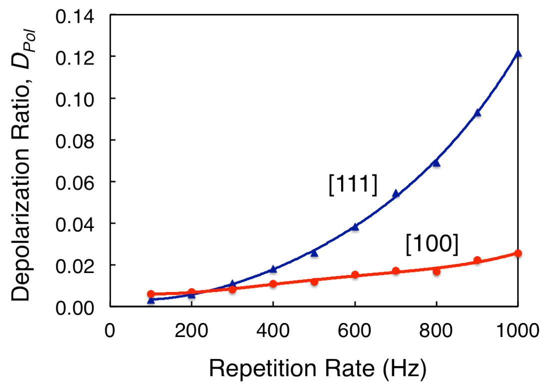

Fig. 2. Depolarization ratio versus repetition rate using [111]-cut and [100]-cut Nd:YAG crystals.

References:

[1] Q. Lu, N. Kugler, H. Weber, S. Dong, N. Muller, and U. Wittrock, "A novel approach for compensation of birefringence in cylindrical Nd:YAG rods," Opt. Quantum Electron. **28**, 57-69 (1996).
[2] I. Shoji and T. Taira, "Intrinsic reduction of the deporaization loss in solid-state lasers by use of a (110)-cut $Y_3Al_5O_{12}$ crystal," Appl. Phys. Lett. **80**, 3048-3050 (2002).
[3] H. Tunnermann, O. Puncken, P. Wesels, M. Frede, J. Neumann, and D. Kracht, "Linearly polarized single-mode Nd:YAG oscillators using [100]- and [110]-cut crystals," Opt. Express **19**, 12992-12999 (2011).
[4] R. Bhandari and T. Taira, "Efficient second to ninth harmonic generation using megawatt peak power microchip laser," Opt. Express **21**, 28849–28855 (2013).