コーナーキューブレトロリフレクター共振器のレーザー特性

Laser characteristics of corner cube retro-reflector resonator

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Introduction

Corner-cube retro-reflector (CCR) is an optical element with interesting reflective and polarization characteristics. One of its properties is that the collimated radiation is reflected back in the direction that is counter-parallel to the incident beam. Another property of the CCR is that the reflected beam has coherent properties, which could be used for passive intra-resonator coherent beam combining (CBC).

In our previous report [1] we presented and discussed basic polarization properties of corner-cube retro-reflectors. Here we will present comparative results on lasing characteristics of conventional and CCR resonators.

Experimental Setup, Results and Discussion

The experimental resonator setup used in this study is schematically illustrated in Fig. 1.

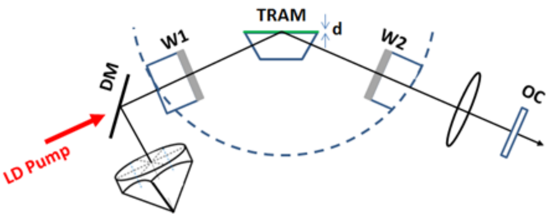

Fig.1. Experimental setup diagram for comparative investigations of lasing characteristics for resonators with conventional high-reflective mirror and CCR.

Cryogenically (LN_2) cooled YAG total reflection active mirror (TRAM) with 9.8 at % Yb doped and d = 0.2 mm thickness was used as an active medium. The total length of the resonator was set to be 460 mm while the LD excitation (P_{max} ~ 200 W) spot was kept at ~ 1.8 mm in diameter. Both, a conventional 100 % reflective mirror (Fabry-Perot (FP) resonator) and a CCR were used as high reflective elements in the resonator. The threshold and the slope efficiencies were estimated to be about 235 W/cm^2 and 0.5 (at 3 times the threshold), and 800 W/cm^2 and 0.35 (at 2 times the threshold) for FP and CCR resonators, respectively. The marked increase of the laser threshold for CCR resonator is explained by the small beam diameter on the CCR, incurring fractionally large losses due to the scattering on the tip and corners of the CCR.

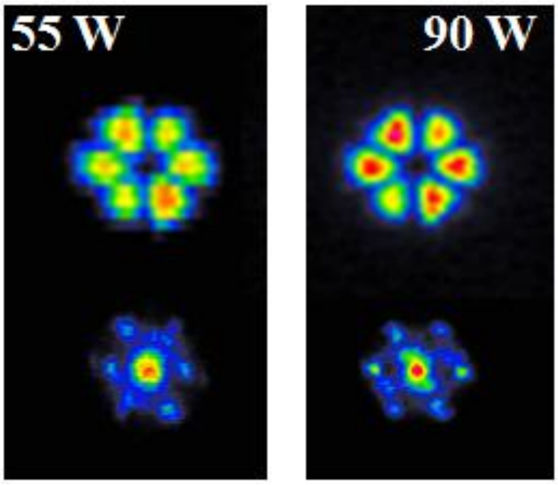

Fig.2. NF (top) and FF (bottom) intensity distribution patterns of a CCR resonator laser beam for 55 W (left) and 90 W (right) absorbed pump power cases, corresponding to ~5 W and ~17.5 W output powers, respectively.

In Fig. 2, NF and FF output intensity distributions of CCR resonator for two absorbed pump power cases are shown. Firstly, it is seen that thermal effects hardly affect the main features of the beam profiles. Second, although the NF intensity profiles look like the higher order Laguerre-Gaussian mode LG03, the FF patterns unambiguously demonstrate that the six separated beam parts are coherent and in-phase, demonstrating the coherent nature of the CCR reflected beams and possibility of passive intra-resonator coherent beam combination (CBC), when a CCR is used as a high reflection element.

Summarized, experimental study of the CCR resonator characteristics in comparison with traditional FP resonators is presented and discussed.

[1] H. Chosrowjan and S. Taniguchi, 第64回応用物理学会春季学術講演会、14p-P6-10