アキシコンレトロリフレクター共振器のレーザー特性

Laser characteristics of axicon retro-reflector resonator

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Introduction

Axicon retro-reflector or axicon lens (AL) with 90 degrees apex angle is an optical element with interesting reflective and polarization characteristics. One of its properties is that the collimated radiation normally incident on AL with 90 degrees apex angle is reflected back in the counter-parallel direction of the incident beam. Another property of the AL is that the reflected beam has coherent properties, which could be used for passive intra-resonator coherent beam combining (CBC).

In our previous reports [1] we presented and discussed basic polarization properties of axicon lens and corner-cube (CCR) retro-reflectors. Here we will present comparative results on lasing characteristics of conventional-, corner-cube and AL resonators.

Experimental Setup, Results and Discussion

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

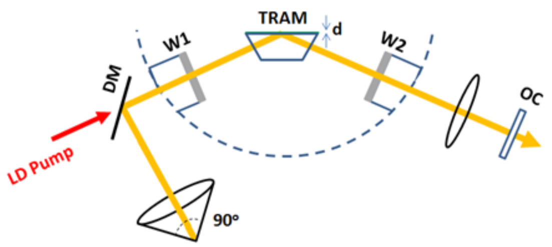

Fig.1. Experimental setup diagram for comparative investigations of lasing characteristics for resonators with conventional high-reflective mirror, CCR and AL with 90 degrees apex angle.

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. Conventional 100 % reflective mirror (Fabry-Perot (FP) resonator), a CCR and an AL were used as high reflective elements in the resonator, respectively. The laser threshold and the slope efficiencies were estimated to be about 235 W/cm^2 and 0.5 (at 3 times the threshold), 470 W/cm^2 and 0.4 (at 2 times the threshold) and 800 W/cm^2 and 0.35 (at 2 times the threshold) for FP, AL and CCR resonators, respectively.

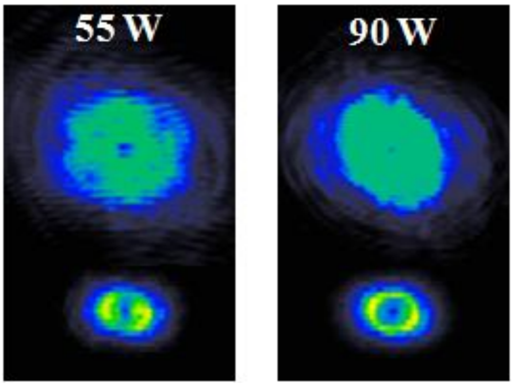

Fig.2. NF (top) and FF (bottom) intensity distribution patterns of an AL resonator laser beam for 55 W (left) and 90 W (right) absorbed pump power cases, corresponding to ~ 10 W and ~ 24 W output powers, respectively.

Marked increase of the laser threshold for CCR and AL resonators is explained by the small beam diameter on those elements, incurring fractionally large losses due to the scattering on the tip of the AL and three corners of the CCR, respectively.

In Fig. 2, NF and FF output intensity distributions of AL resonator for two absorbed pump power cases are shown. It is seen that thermal effects for presently applied pump powers hardly affect the main features of the beam intensity profiles. The FF patterns unambiguously show that the beam parts are coherent and in-phase, demonstrating the possibility of passive intra-resonator CBC when an AL is used as a high reflection element.

[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; 第78回応用物理学会秋季学術講演会、6p-PA1-5;