コーナーキューブおよびアキシコンレトロリフレクタ共振器のレーザー発振特性とその温度効果

Lasing characteristics of corner-cube and axicon retro-reflector resonators at cryogenic and ambient temperatures

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Introduction

Corner-cube retro-reflectors (CCR) and axicon lenses with 90 degrees apex angle (AL) are optical elements with interesting reflective and polarization characteristics. One of their properties is that the collimated radiation incident on both elements (arbitrarily direction for CCRs and normal incident for AL) is reflected in the direction that is counter-parallel to the incident beam. Another common property of both elements 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 AL and CCR retro-reflectors and some lasing characteristics of Fabry-Perot (FP), CCR and AL resonators. In this contribution we will present and discuss lasing characteristics of CCR and AL retro-reflector resonators at ambient temperature in comparison with cryogenic cooling case. Furthermore, lasing mode selection under high thermal load conditions for FB and AL resonators will be discussed as well.

Experimental

Composite YAG total reflection active mirror (TRAM) with 9.8 at % Yb doped and d = 0.2 mm thickness was used as an active medium at cryogenic temperatures. The LD excitation (P_{max} ~200 W) spot was kept at ~1.8 mm in diameter. A mirror, CCR or AL were used as high reflective elements in the resonator, respectively. The laser threshold and the slope efficiencies have been estimated. 9.8 at% doped Yb:YAG TRAM with d = 0.6 mm thickness was used as an active medium in lasing experiments at ambient temperature. The LD excitation (P_{max} ~600 W) spot was kept at ~5 mm in diameter.

At higher pump power conditions (CW, up to ~550 W) the near field (NF) and far field (FF) profiles of FP resonator output continuously changed, indicating that the laser resonator enters a multi-mode regime and no mode selection occurs, i. e. high order resonator modes were not suppressed. In contrary, for AL resonator even at higher pump powers the FF profiles did not change, indicating that intra-resonator mode selection occurs, and high order resonator modes are suppressed (Fig. 1).

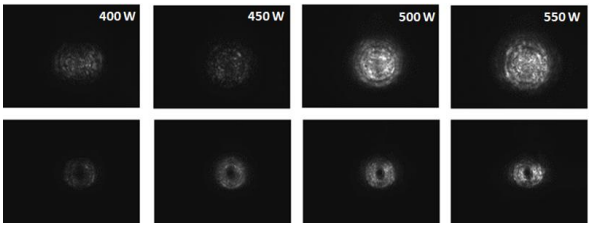

Fig.1. NF (top) and FF (bottom) lasing profiles of AL resonator at different pump powers.

Summarized, study of ambient temperature Yb:YAG TRAM lasing characteristics based on resonators with retro-reflective elements is underway. Although several characteristics of resonators with CCR and AL elements have been already recognized, more detailed investigations using CW systems are hindered by the insufficient pump densities. Potential benefits of CCR and AL resonators could be further investigated in laser systems with pulsed regime operation.

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