A Study of pulse heterodyne of Z-Fold waveguide CO_2 laser

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Abstract:

Pulse heterodyne of electrooptically Q-switched RF excited Z-fold waveguide CO_2 laser with two channels (partial Z-fold channel and single channel) and common electrodes are presented. The Heterodyne waveform of the pulsed laser and the CW laser are compared to pulse waveform of Q-switched laser. CW laser output has been obtained from the single channel. Pulse width is 140 ns, the delay 300 ns and the peak power 300W. The largest tunable range of heterodyne frequency is 150 MHz and the width of the voltage pulse on the crystal is about 1.2μs.

Keywords: Waveguide CO_2 laser, Q-switched , Pulse heterodyne, RF excited

Introduction

The CO_2 waveguide laser is one of the ideal devices for heterodyne detection .It has many applications, such as speed measurement, laser imaging, and laser radar. Generally, heterodyne detection needs two lasers a local laser and a transmitter laser [1-5] .Both lasers need high frequency stability to ensure high heterodyne frequency stability so as to improve the heterodyne detection efficiency .Besides, the pulsed transmitter laser should have higher output power for far target detection .At present, two independent lasers with complex structure of frequency stabilization are often needed in order to obtain stabilized heterodyne signals. However, the lasers may suffer from possibly unacceptable penalties of increased size, weight, complexity and cost. Abramski [6] reported a method to use an RF excited waveguide CO_2 laser array to obtain stabilized heterodyne signal, but it is not easy to insure which branch the laser works on due to the plane resonator. In addition, it is difficult to insert a modulator crystal and other optical elements into the resonator due to the close distance between the two channels and the same direction of laser output.

With those aims, a radio frequency (RF) excited tunable Q-switched partial Z-fold CO_2 waveguide laser with two channels and common electrodes has been designed and manufactured (Chinese Patent Number: ZL02 1 23786.7)[7-9]. The laser output directions from the two channels are opposite. The two channels are excited by the same RF source. CW laser output can be obtained from one of the channels with grating tuning and the laser frequency can be tuned by a piezoelectric transducer (PZT). Elecrooptically Q-switched pulsed laser output is achieved from the partial Z-fold channel also with grating tuning. The experimental measurement and result for laser output power of partial Z-fold channel and single channel are presented .Two lasers are combined onto a HgCdTe detector, and stable pulse heterodyne waveform and its Fourier transform frequency spectrum were also observed.

Experimental results

The schematic of the experimental arrangement is shown in Fig.(1) . The laser designed by us is a Q-switched Z-fold CO_2 laser with two channels [7-10]. The two waveguide channels consist of two alumina side walls with aluminium top and bottom electrodes . The partial Z-fold channel is 3x460 mm in length and the single one is 460 mm with a cross-section of all the waveguides is 2.25x2.25 mm^2 are put into a stainless steel vacuum envelop .In order to insure the RF voltage distribution along the electrodes uniformly and each channel can discharge at the same time, a distance between the two channels is 20 mm. The whole two-channel waveguide electrodes are placed in a stainless steel vacuum volume with water-cooled , and the laser works in sealed operational mode. .The laser utilized a parallel-resonant distributed inductance technique to uniformly