

§20. Development of Powerful 57 μ m CH3OD Laser and the Detector for High Density Plasma Diagnostics

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We have developed a powerful and stable 119- μ m CH3OH laser pumped by 9P(36) cw CO2 laser for the optical source of LHD diagnostics[1,2]. The laser system is installed in 13-ch interferometer and is using routinely as the probing source[2]. For high density operation of LHD and large plasma machine such as ITER, short wavelength far-infrared (FIR) lasers of 40- to 70- μ m range should be useful rather than the 119- μ m laser and 10- μ m CO2 laser from the view points of refraction and vibration effects and amount of fringe shifts in the interferometer. For the purpose, we have searched powerful short wavelength FIR lasers from methanol and the isotopes pumped by cw CO2 lasers[3]. As the result, we have discovered that a 57- μ m CH3OD laser pumped by 9R(8) CO2 laser is the most powerful line under 100 μ m range.

In this experiment, a twin type laser pumped by cw CO2 laser has been used[4]. The CO2 laser is about 3 m in length, and the cavity is formed by a grating (150 lines/mm) and a ZnSe output mirror (55% reflection for 10.6 μ m) attached on PZT. The maximum output power is over 200 W for 10P(20) line. The FIR laser is about 2.9 m in length, and the laser tube diameter is 25 mm. The laser cavity is formed by a plane metal mirror having off-axis input coupling hole (3 mm) and a Si hybrid mirror having an FIR output coupling hole of 14 mm at its center. The output coupling mirror and FIR laser window are optimized for 119- μ m CH3OH laser. Using this laser system we have obtained 119- μ m CH3OH laser output power of 0.68W.

On the CH3OD laser pumped by 9R(8) CO2 laser, 57- μ m and 47- μ m lines have been observed. But, the two laser lines can be selected easily by using an FIR polarizer, because the polarization of 57- μ m laser is perpendicular and that of 47- μ m laser is parallel for that of pumping CO2 laser. The pressure dependence of the laser outputs is shown in Fig.1. Addition of He to CH3OD is effective for the 57- μ m laser output same as the case of 119- μ m CH3OH laser(Fig.2). The maximum output power over 0.53W has been obtained by 125W CO2 laser pumping.

For the 57- μ m (5.2 THz) detector, a GaAs Schottky barrier diode (SBD) has been tested. The detector is constructed with a corner cube mount developed by NIFS and a diode chip supplied by Tohoku University. The video sensitivity of the detector has been estimated to be 3V/W.

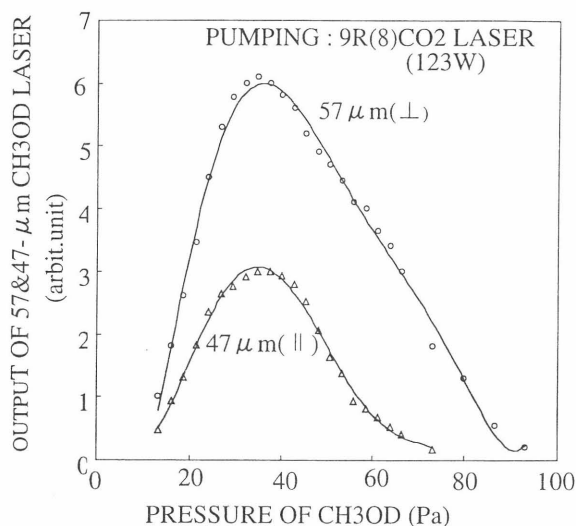


Fig.1. Pressure dependence on output power of 57- μ m and 47- μ m CH3OD Laser.

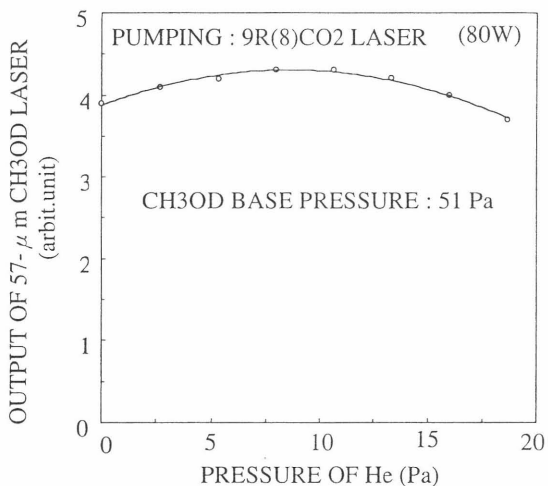


Fig.2. The effect of He for 57- μ m CH3OD laser output power.

References

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- 4) Okajima, S., et.al., Ann. Rep. NIFS, April 1998-March 1999 (1999) 148.