§5. Development of Short Wavelength Far-Infrared Lasers Pumped by CW CO_2 Laser

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For interferometer of LHD, we have developed powerfull and stable 119-μm CH_3OH laser and 184-μm CH_2F_2 laser pumped by cw CO_2 laser [1]. For the higher density operations of LHD and for future large machine such as ITER, FIR (Far Infrared) lasers of from 40 to 100 μm in wavelength may be useful rather than the long wavelength FIR lasers mentioned above and 10-μm CO_2 laser from the view points of refraction and vibration effects and fringe shifts in the interferometer. On this wavelength region of FIR laser spectrum, lasers from CH_3OH and the isotopes have a dominant role. However, the details on available lasing line, the power level and the pressure dependence have not been so well known. In order to establish new optical sources for LHD diagnostics, we have measured the characteristics for CH_3OH[2], CD_3OH[2,3], CH_2DOH and NH_3 lasers. Table 1 shows the powerful laser lines from CH_2DOH and NH_3 obtained with our R&D laser system. From the results, 70.5-μm laser (65 mW) from CH_3OH[2], 51-μm laser (17 mW) from CH_2DOH and 67-μm laser (43 mW) from NH_3 will be useful for future plan of LHD diagnostics. Figure 1 and 2 show the detuning curve of 67-μm NH_3 laser and the pressure dependence of output power. The optimization of the laser cavity for short wavelength FIR laser is proceeding now.

References
1) Okajima, S.,Kawahata, K., et.al., Proc. of 7th Int. Sympo. Laser-Aided Plasma Diagnostics , (1995, Fukuoka) 148.
2) Okajima, S.,Kawahata, K., et.al., Proc. of 21th Int. Conf. IR and MM Waves, (1996, Berlin) CT12.
3) Okajima, S.,Kawahata, K., et.al., Ann. Rev. NIFS, 1995-1996 (1996) 103.

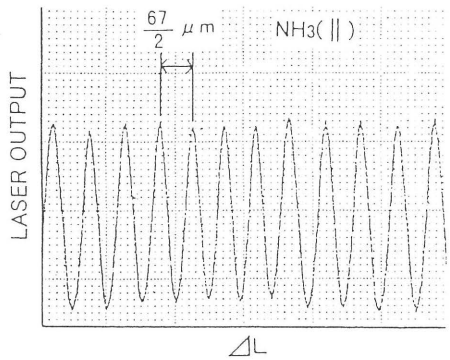

Fig.1. Detuning curve of 67-μm NH_3 laser pumped by 9R(30) CO_2 laser.

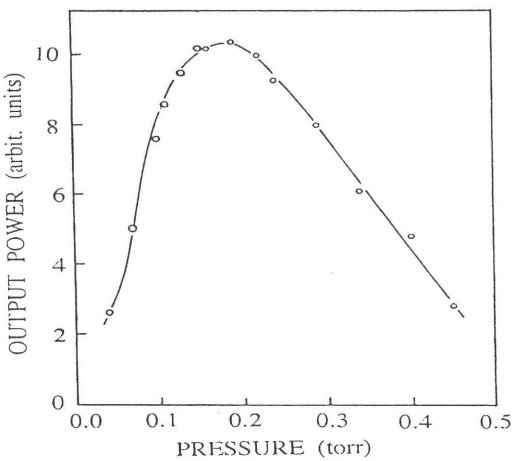

Fig.2. Pressure dependence of 67-μm NH_3 laser output. (Pump power : 54 W)

Table 1 CH_2DOH and NH_3 lasers pumped by cw CO_2 laser. (Diameter of FIR laser tube : 25 mm)

CO_2 laser		CH_2DOH			
line	power[W]	wavelength[μm]	pol.	pressure[torr]	power[mW]
9P(10)	65	183.6	∥	0.19	10
9P(12)	56	108.8	∥	0.31	16
	56	112.5	∥	0.31	38
9P(14)	85	206.7	∥	0.17	19
9P(16)	91	102.0	⊥	0.29	15
9P(30)	95	44	∥	0.13	6
10R(34)	74	150.8	∥	0.26	22
	74	* 156	⊥	0.09	7
10P(26)	110	150.6	⊥	0.23	24
10P(34)	91	124.4	∥	0.43	63
10P(46)	43	* 51	⊥	0.2	17
CO_2 laser		NH_3			
line	power[W]	wavelength[μm]	pol.	pressure[torr]	power[mW]
9R(30)	54	67	∥	0.23	43

* : new line