§4. Development of Optically-Pumped cw Methanol Laser at 40- to 100-μm Wavelength Range

Okajima, S. (Chubu Univ.)
Kawahata, K., Ejiri, A., Tanaka, K., Hamada, Y., Fujita, J.

Development of high power cw FIR (Far-infrared) laser is of important for plasma diagnostics and many other practical applications. For recent large plasma machines, powerful laser lines of from 100 to 200 μm in wavelength are using as optical sources of the interferometers. We have developed stable 119-μm CH_3OH-laser and 184-μm CH_2F_2-laser pumped by high power cw CO_2 laser with a R&D device [1-3], and have newly constructed a twin FIR laser system for the interferometer of LHD [4]. For the higher density operations of LHD and for future large machine such as ITER, FIR lasers of from 40 to 100 μm in wavelength may be useful rather than the lasers mentioned above and 10-μm CO_2 laser from the view points of refraction and vibration effects and fringe shifts in the interferometer. For this part in FIR spectrum, methanol (CH_3OH and the isotopes) lasers have a dominant role for the efficiency and for the number of available laser lines. However, few attempts have been carried out to know the characteristics and to optimize the performance of the methanol lasers at the wavelength range. In order to establish the optical sources at the short wavelength range in FIR spectrum, we have tried lasing from CH_3OH and CD_3OH with the R&D device [1-3].

Table 1 shows the observed FIR-laser lines and the characteristics. The laser power was measured by using a Scientech 36-001 disk calorimeter. In Table 1, the values without calibration for wavelength of the power meter are shown. Figure 1 and 2 show the pressure dependence of the laser outputs for 52.9-μm and 70.5-μm lines. In these lasers, the output power is fairly low because the output coupler of the FIR laser cavity is not optimized yet for the wavelength.

References
1) Okajima, S.,Kawahata, K., et.al., Ann. Rev. NIFS, 1991-1992 (1992) 77.
2) Okajima, S.,Kawahata, K., et.al., Ann. Rev. NIFS, 1992-1993 (1993) 65.
3) Okajima, S.,Kawahata, K., et.al., Ann. Rev. NIFS, 1993-1994 (1994) 82.
4) Kawahata, K., Ejiri, A., et.al., Ann. Rev. NIFS, 1993-1994 (1994) 81.

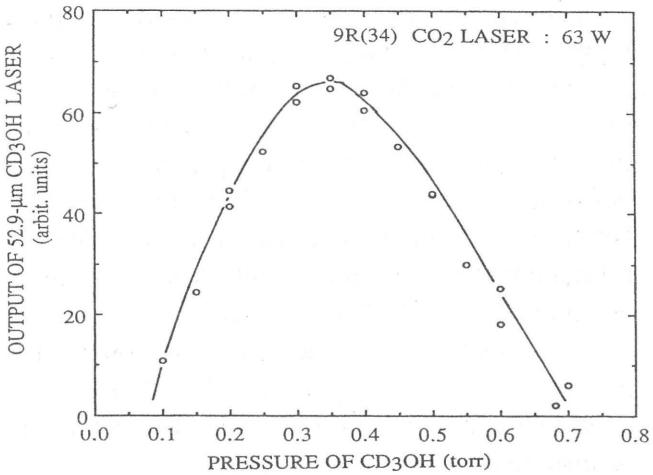

Fig. 1. Pressure dependence of 52.9-μm CD_3OH laser pumped by 9R (34) CO_2 laser.

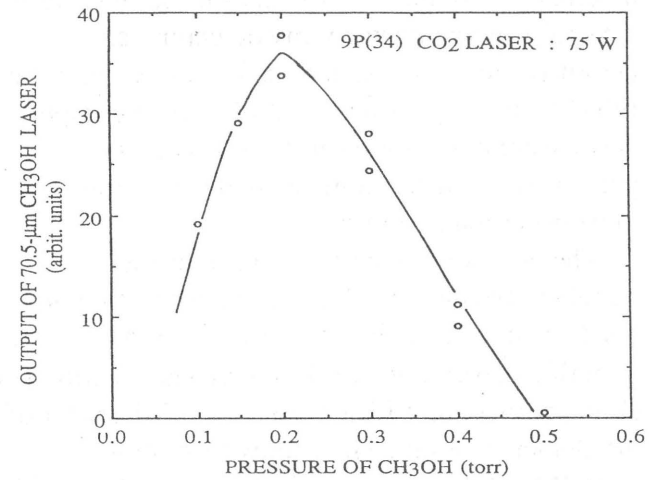

Fig. 2. Pressure dependence of 70.5-μm CH_3OH laser pumped by 9P(34) CO_2 laser.

Table 1. Methanol lasers of 40- to 100-μm wavelength range and the characteristics.

CO_2 laser		FIR laser				
line	power(W)	molecule	wavelength(μm)	pol.	pressure(torr)	power(mW)
9R(10)	57	CH_3OH	96.5	∥	0.37	49
9R(28)	81	CD_3OH	55.6	⊥	0.3	3.5
	78	CD_3OH	42.6	∥	0.4	
9R(34)	63	CD_3OH	52.9	⊥	0.35	10.1
9P(34)	75	CH_3OH	70.5	⊥	0.2	61.6