§17. Development of a Single-mode, High Power Far Infrared Laser System for Ion Thomson Scattering

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So far, we have developed the far-infrared laser system including the detection system[1] for the ion Thomson scattering. As we have shown previously, the D_2O laser operated with a multiple spectral structure consisting of several narrow-band longitudinal components.[2] And we have shown that it was possible to determine the ion temperature accurately via a collective Thomson scattering using the multimode D_2O laser.[3] In spite of this fact, it will be important to achieve a single mode operation of a high power, pulsed far infrared laser for the future application to plasma diagnostics. Thus, we have constructed a compact single mode D_2O laser with a cavity length of 80 cm. Using a high frequency resolved heterodyne detection system, we observed the spectral structure of far-infrared laser emission and found that it consisted of a single longitudinal mode.[4] Application of the compact D_2O laser as a master oscillator in the oscillator-amplifier system is a promising method for obtaining a single mode, high power D_2O laser emission.

In the present research, we have focused upon obtaining a single-mode operation of D_2O laser using an oscillator-amplifier system. Figure 1 shows one example of emission spectra of D_2O laser, measured using the frequency-resolved heterodyne detection system. By tuning a frequency of the injecting compact D_2O laser beam around the center of ASE spectrum of the 4.3 m long D_2O amplifier, we obtained a narrow spectral emission, as shown in Fig. 1(a), where D_2O gas pressure was 4 Torr. At present, output energy of 50 mJ has been achieved in the present oscillator-amplifier system. For comparison, we also showed a typical emission spectrum of the previous D_2O laser in Fig. 1(b). Frequency resolution was 1.3 MHz for both cases.

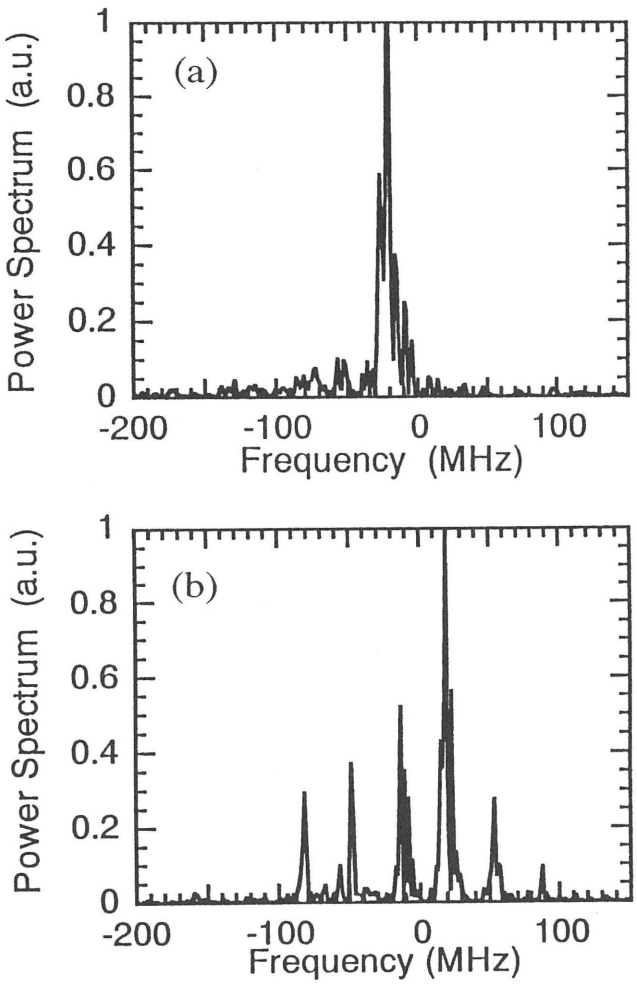

Fig.1 Emission spectra of (a) the present D_2O oscillator-amplifier and (b) the previous D_2O laser obtained at gas pressure of 4 Torr.

References

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2) Nagatsu, M., et al., Jpn. J. Appl. Phys. 31(1992) 3873.
3) Tsukishima, T., et al., Plasma Physics & Contr. Fusion 35 (1993) 1229.
4) Takada, N., et al., pressed in IEICE Trans. Electron (in Japanese) (1994)