§5. Remote Sensing of Density of Carbon Dioxide by LIDAR

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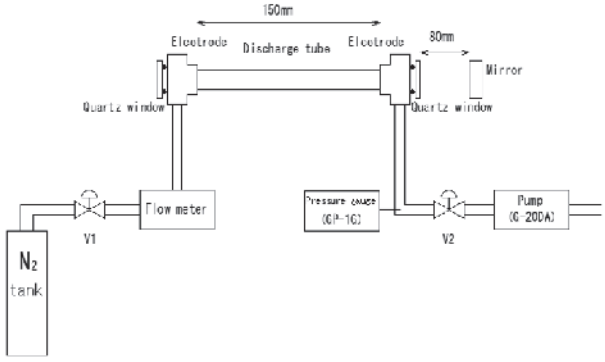
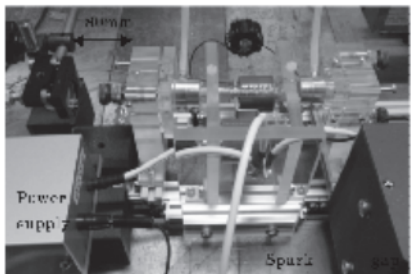
LIDAR(Light Detection And Ranging) is a potentially attractive avenue for remote sensing of carbon dioxide. A nitrogen laser is vavorable for its eye safety radiation. An axially pumped compact nitrogen laser is developed for a LIDAR. As shown in Fig.1, the discharge tube has a pair of electrodes and quartz windows on the both ends. An aluminum mirror R=85% is used for an end mirror. Nitrogen gas flow around 0.3 l/min is supplied from a N_2 tank. Fig.2 shows the its electronic circuit designed for a low-voltage battery.



(a) Layout of the compact nitrogen laser.



(b) Photograph of the compact nitrogen laser.

Fig. 1. Developed axially pumped compact nitrogen laser.

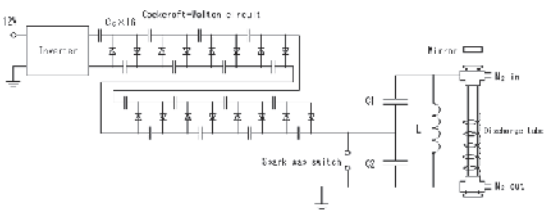
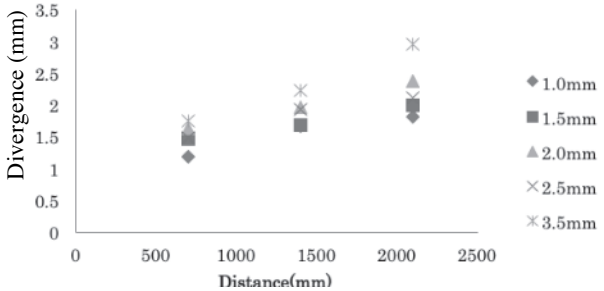
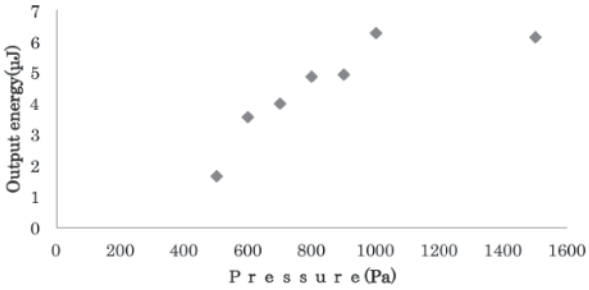


Fig. 2 . The electronic circuit for a low-voltage battery.

The length and inner diameter of discharge tube is experimentally optimized for small beam divergence. The nitrogen gas pressure also optimized for high output energy. The results are plotted in Fig.3. The length of 150mm, inner radius of 2.5mm and pressure of 1kPa are decided as optimum values for this laser additional consideration of stable operation.



(a) Divergence dependency of inner radius.



(b) Output energy dependency of nitrogen pressure.

Fig. 3 Optimization of the nitrogen laser.

As shown in Fig.4, the LIDAR was composed of the nitrogen laser, a Newtonian telescope (f=500mm), a spectrometer (Koukenkougyou, SG-80, 0.7mm resolution), a photomultiplier (Hamamatsu, E717-74), and photon counter (ORTEC, MCS-PCI). The spectrometer is tuned around 1285.5 cm^{-1} for separation from the Raman shift of N_20.

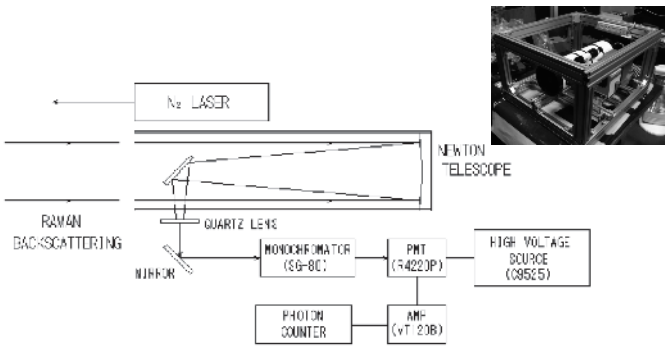


Fig. 4. The compact LIDAR system with the axially pumped nitrogen laser.