



# Fundamental Research for New Far-Infrared Coherent Light Sources

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## Introduction

CO<sub>2</sub> laser emitting coherent far-infrared radiation is used for metals processing, medical surgery, and etc.

### Current CO<sub>2</sub> laser

Gas flow to restrain gas deterioration and to cool the system

It needs high power for gas flow

### Technological review

- Blow-less
- Higher output

### To achieve blow-less CO<sub>2</sub> laser

It needs restraint deterioration of gas.

### What causes deterioration of gas?

Inner electrodes sputtering by gas molecules

We employed electrode-less discharge tube which has no inner electrodes.

Using dielectric-barrier discharge

## Circuit and discharge tube

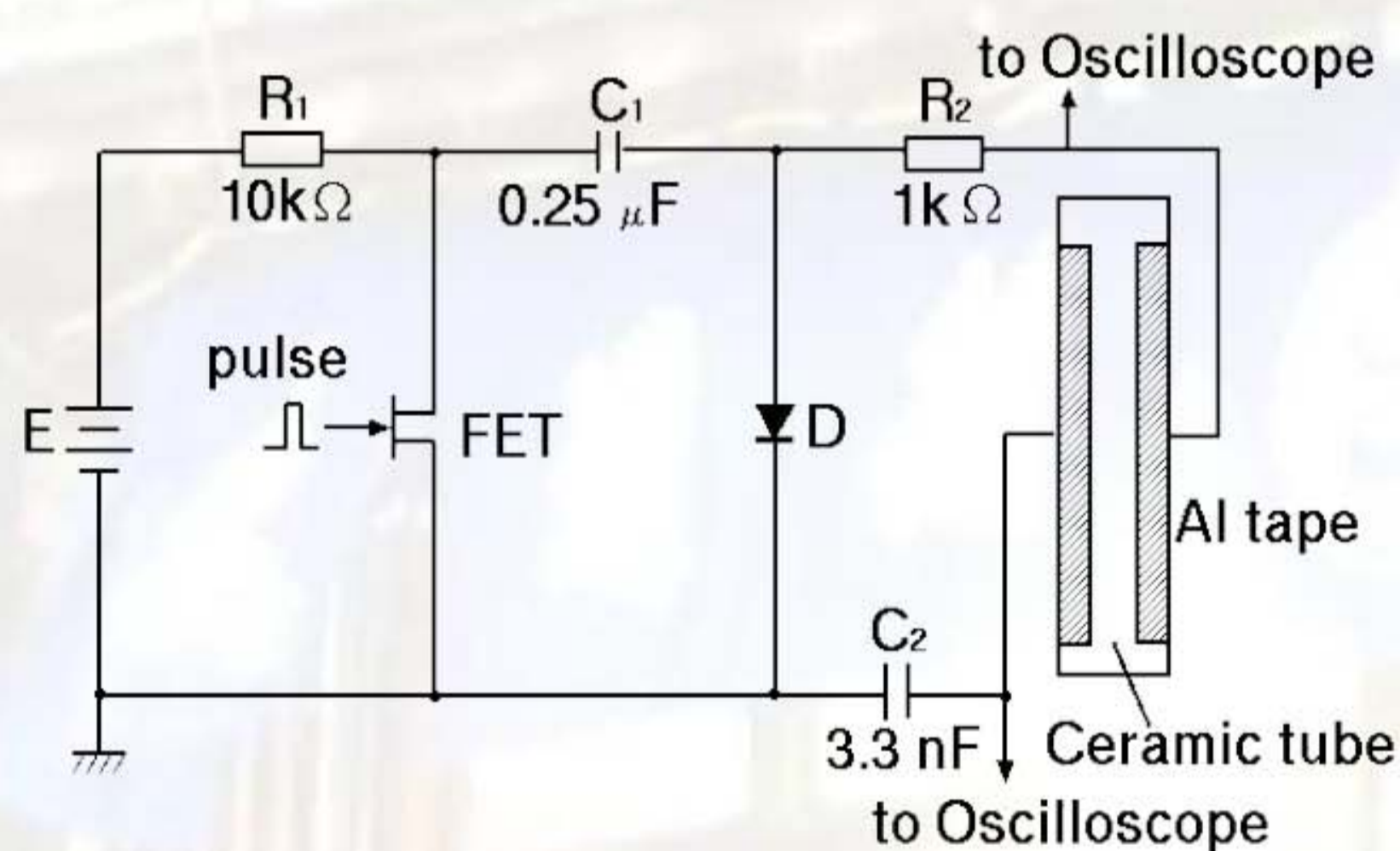


Fig.1 : Circuit (pulsed discharge)

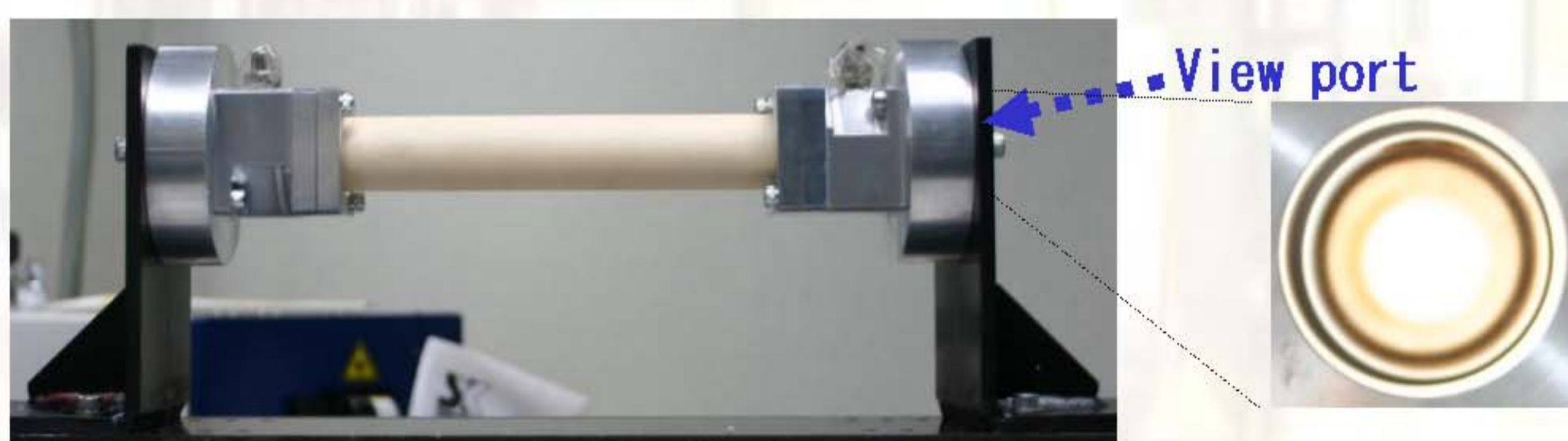


Fig.2 : Discharge tube

Gas  
He:N<sub>2</sub>:CO<sub>2</sub>=74.9:23.4:1.7  
Gas Pressure : 5 kPa  
(7.8 Torr)  
Frequency : 10~50 kHz  
Pulse width : 5 μs

The output power of the DC power supply is almost constant.

## Results

### Electrode arrangement and discharge state

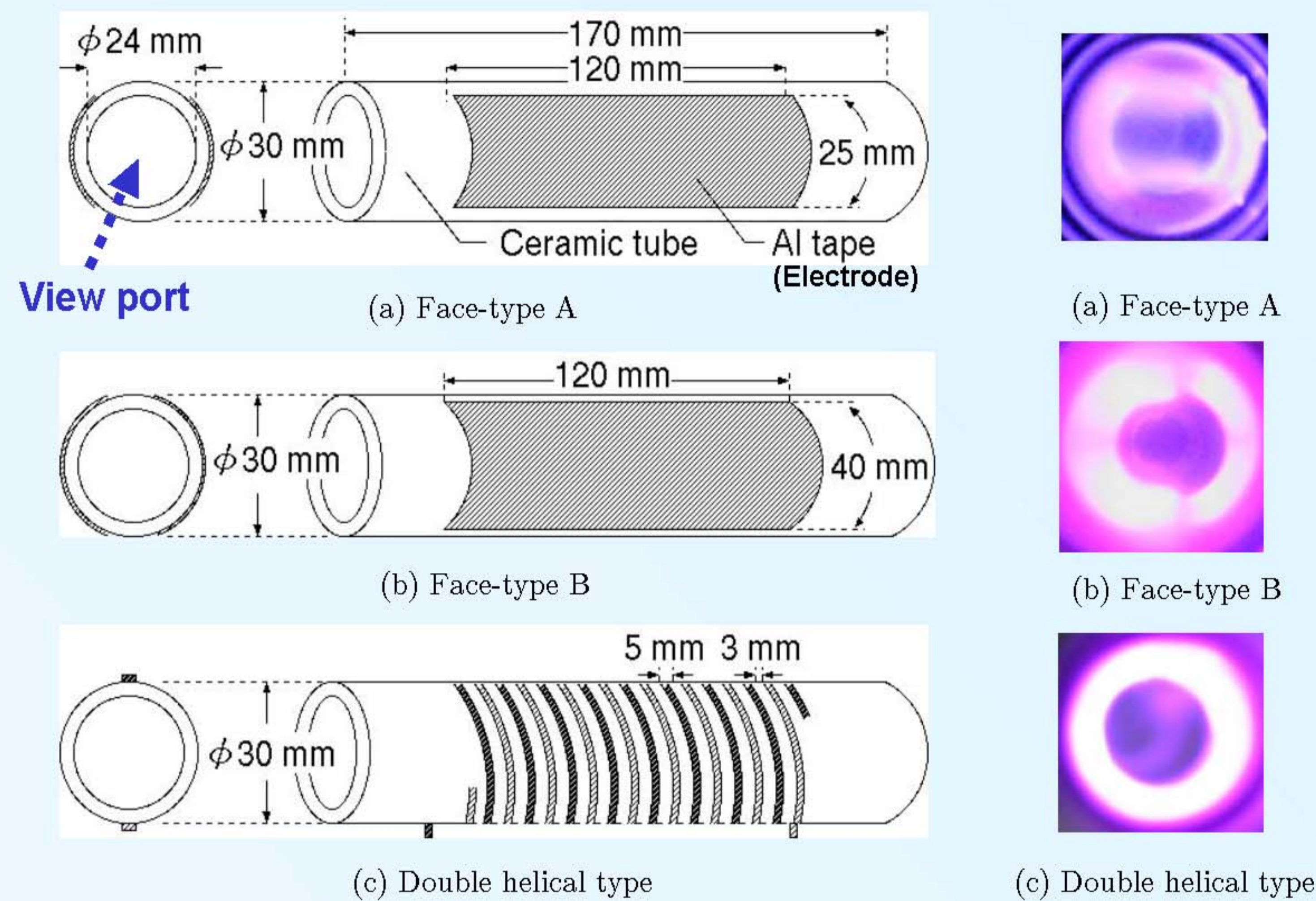


Fig.3 : Electrodes Arrangement

Fig.4 : Discharge state

- At each configuration, plasma is generated near the electrodes and visible emission near center is weak.
- The double helical type generated the most **uniform and symmetrical discharge**.

It is good for laser discharge.

### Frequency vs Input power

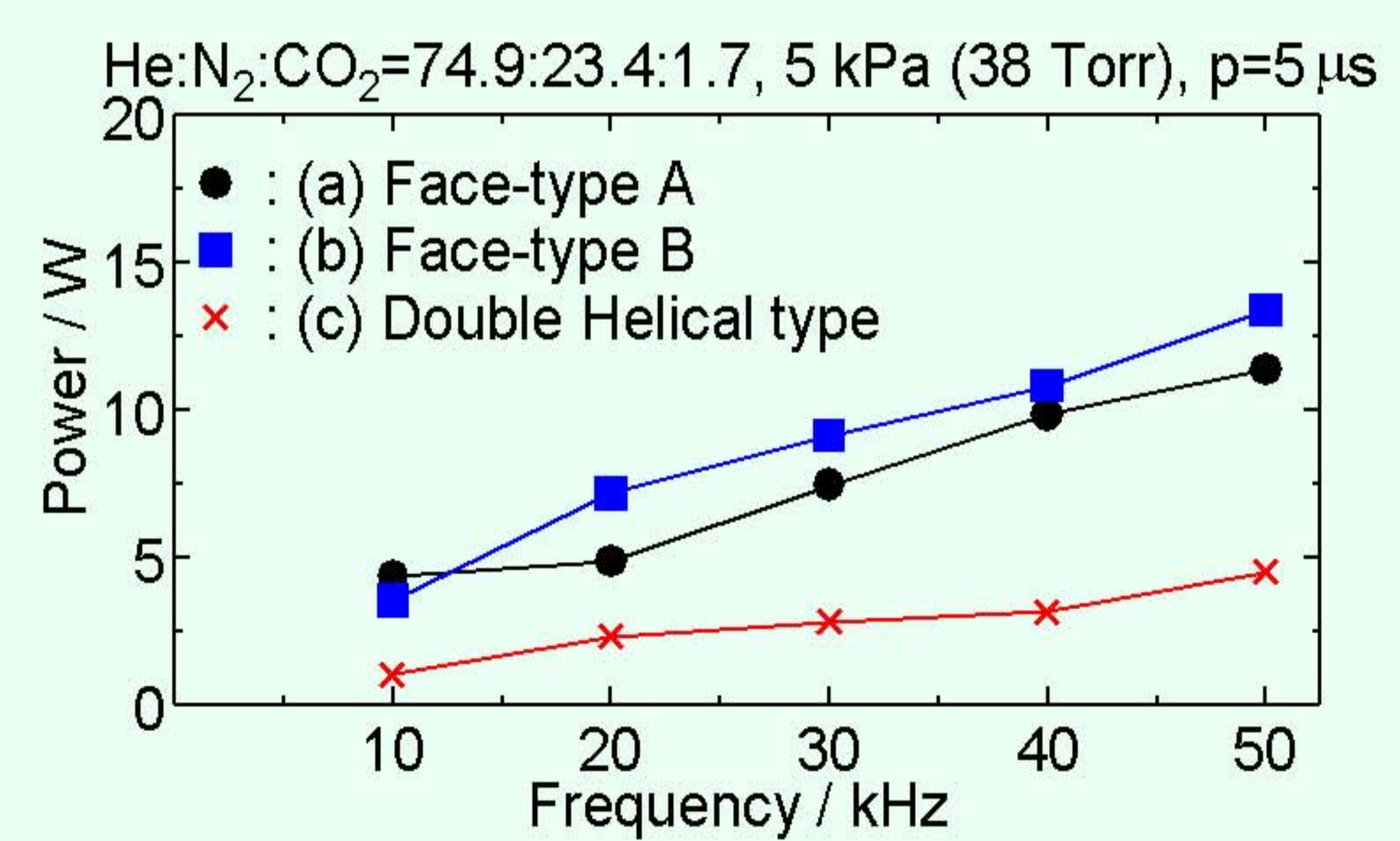


Fig.5 : Frequency versus Input power

- Input power was larger as frequency was higher in every type.
- Input power was the largest when electrode arrangement was face-type B, and was the smallest when electrode arrangement was double helical type.

## Conclusion

It is found that face-type is better than double helical type from the view point of obtaining higher input power to a tube. On the other hand double helical type is better than face-type from the view point of shape and stability of discharge.

Generally **double helical type is suitable for light source of laser** because uniform and symmetrical plasma around the axis of the discharge tube is obtained.