



Waste Treatment by Atmospheric Pressure Plasmas

Takayuki Watanabe, *Kyushu University*

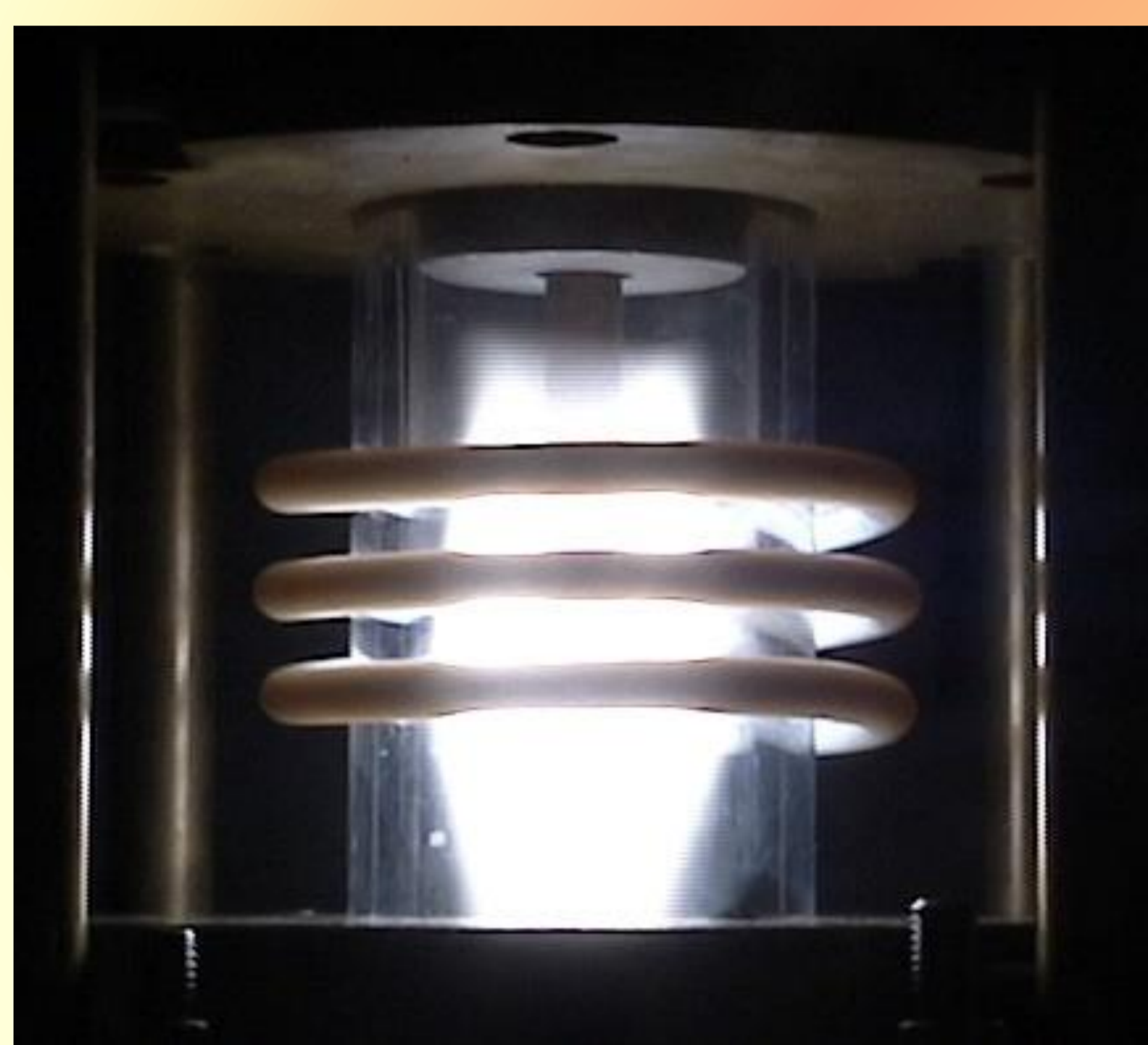
- High enthalpy to enhance reaction kinetics
- High chemical reactivity
- Oxidation and reduction atmospheres
- Rapid quenching (10^6 K/s)



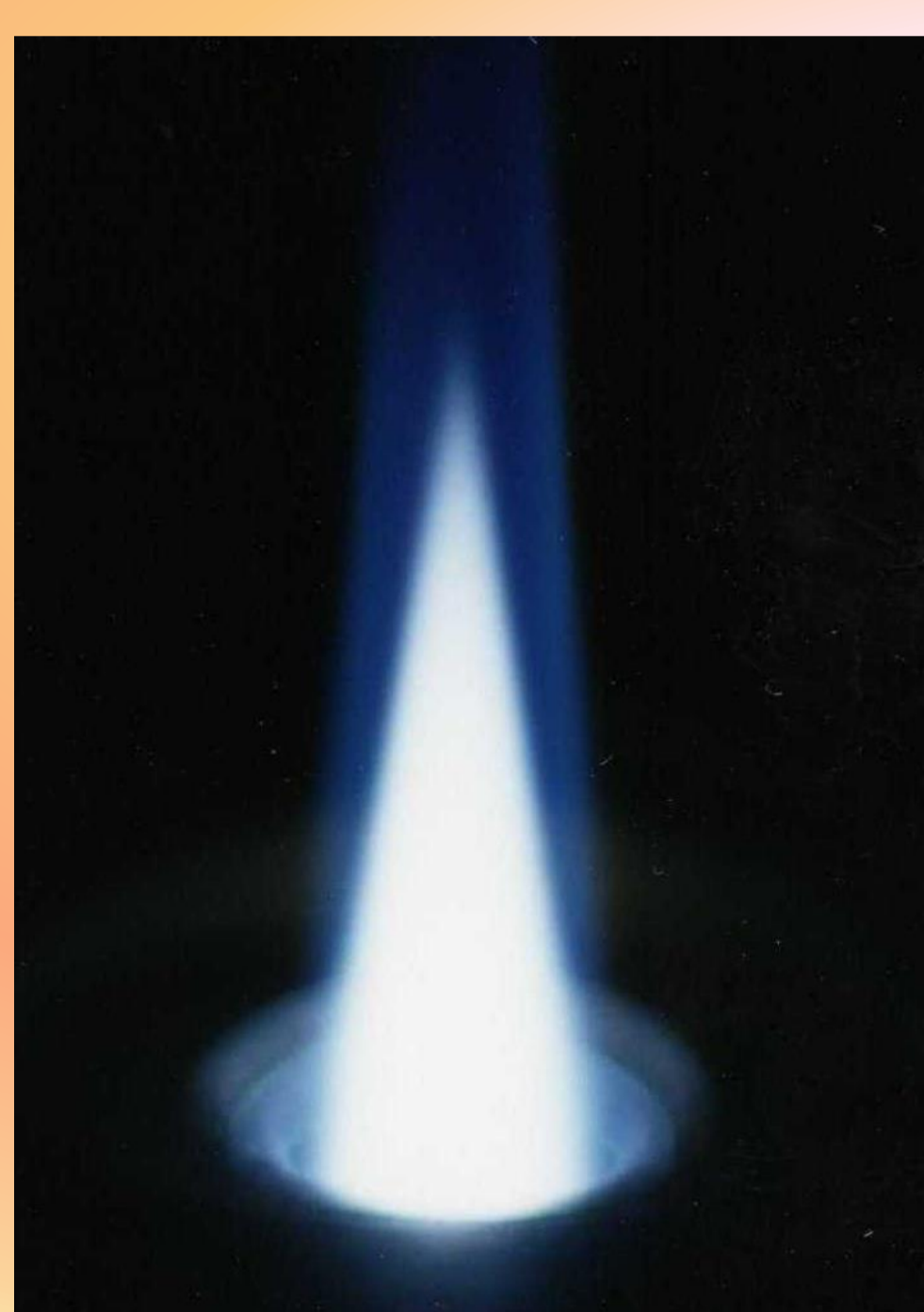
- Low-Level Radioactive Waste
- Ion-Exchange Resin
- Municipal Waste
- Incinerated Ash
- Fly Ash from Melting Furnace
- Gasification



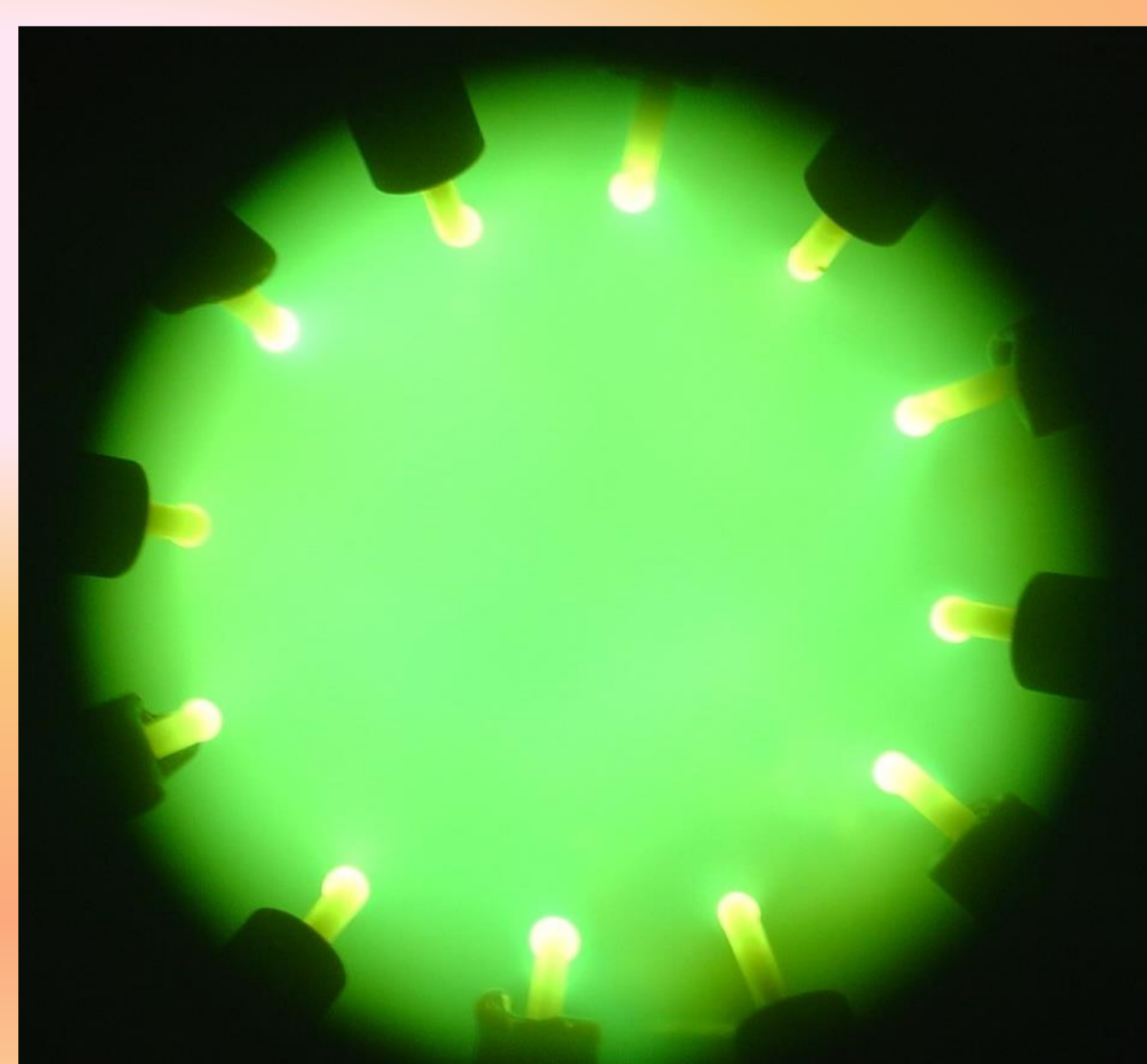
Atmospheric Plasma



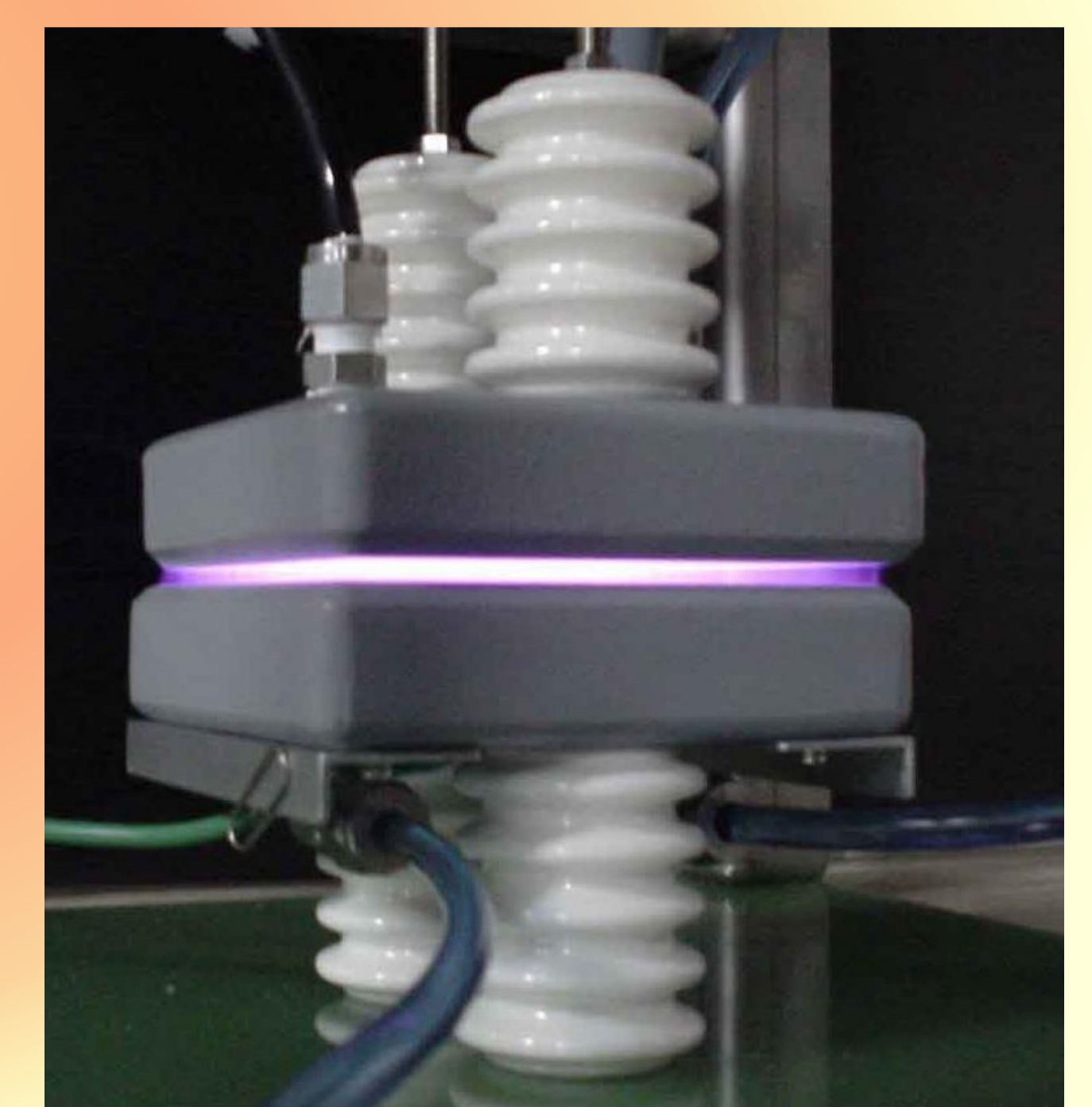
RF Plasma



DC Plasma

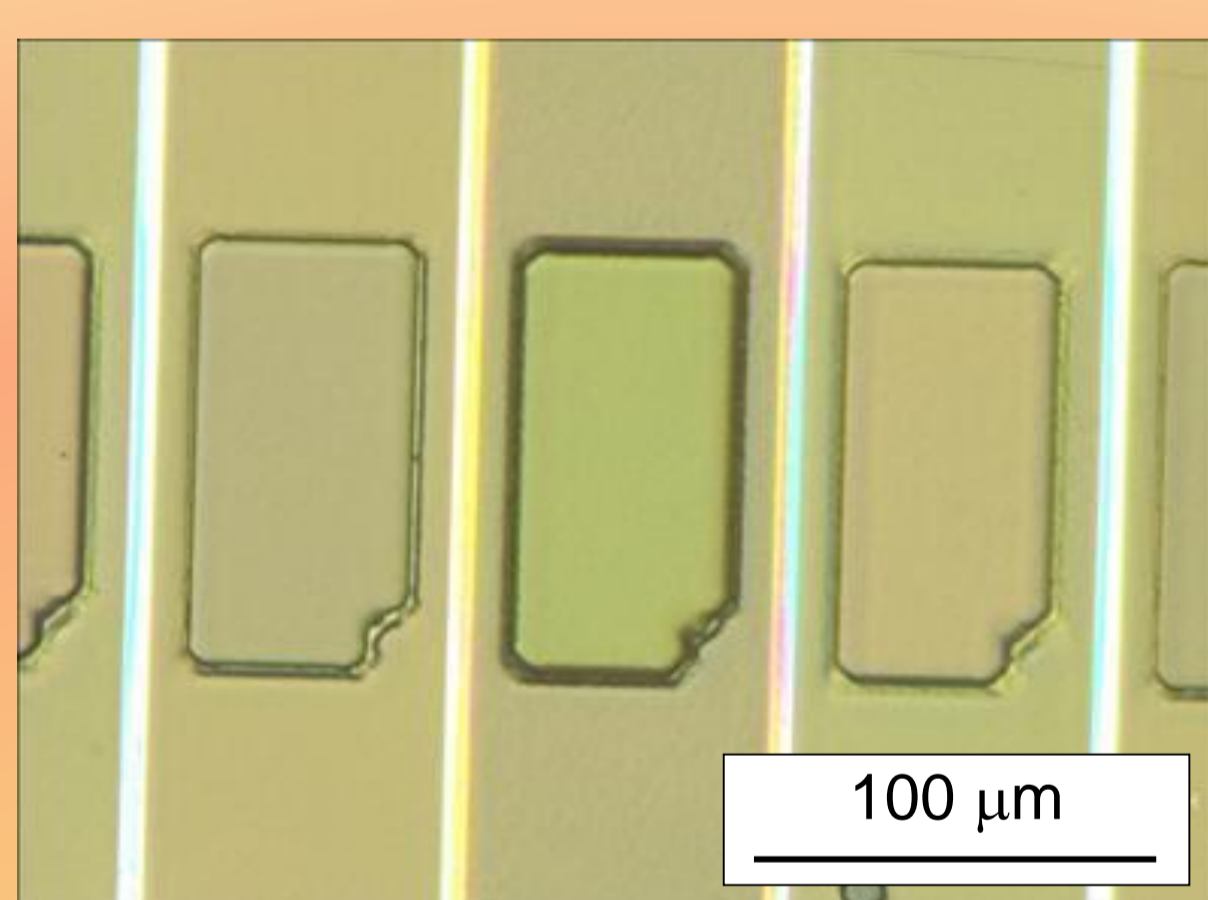
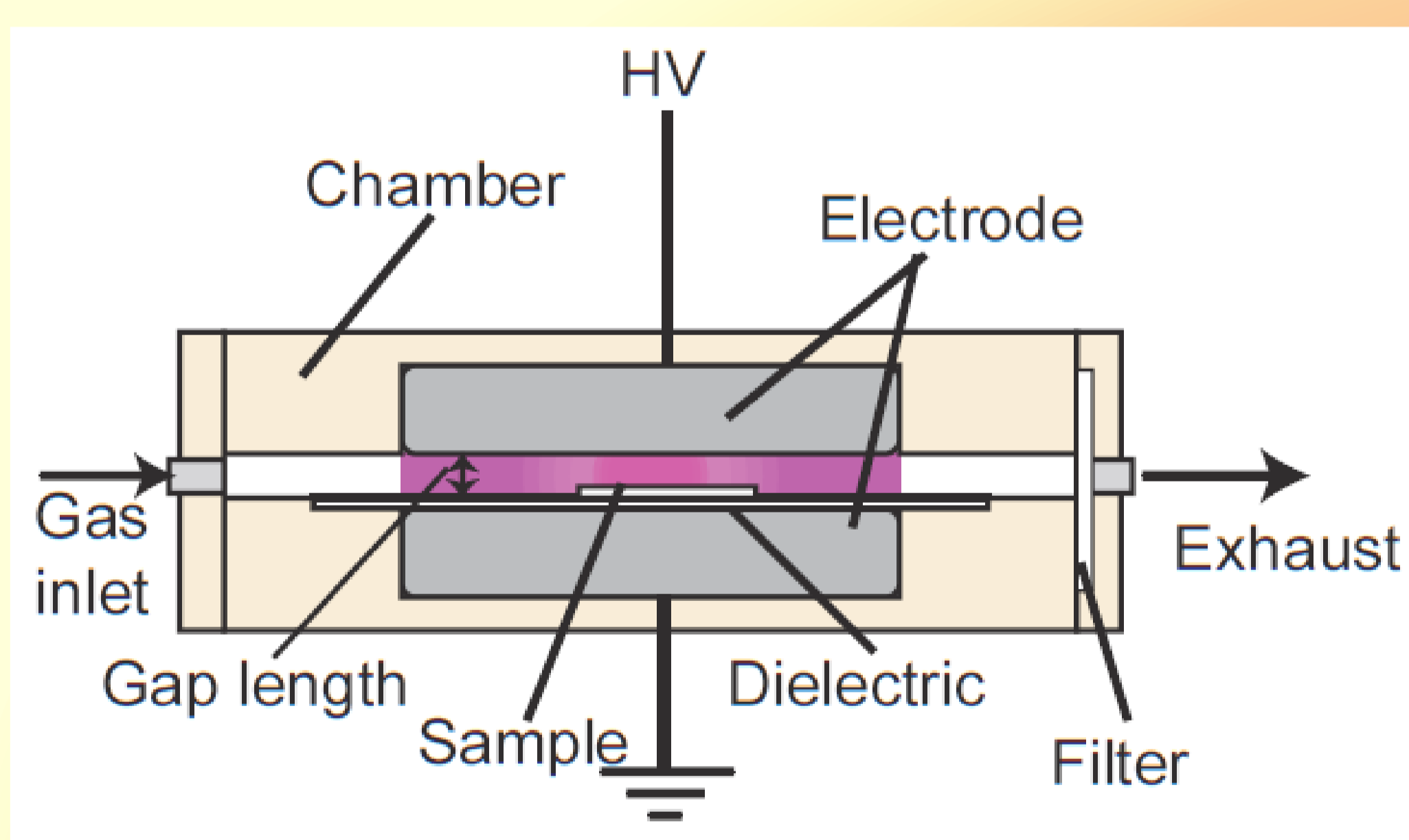


Multi-phase Arc

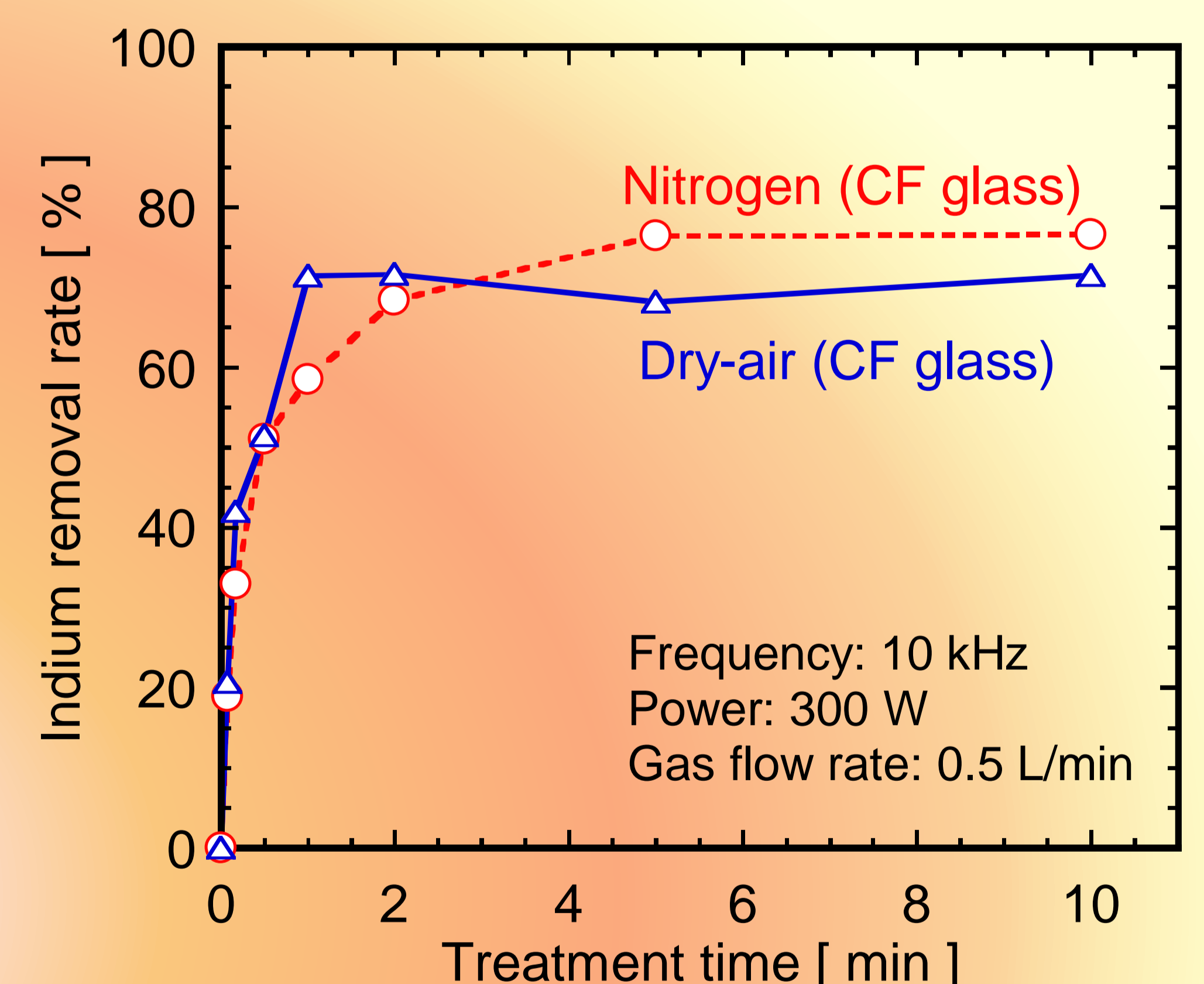
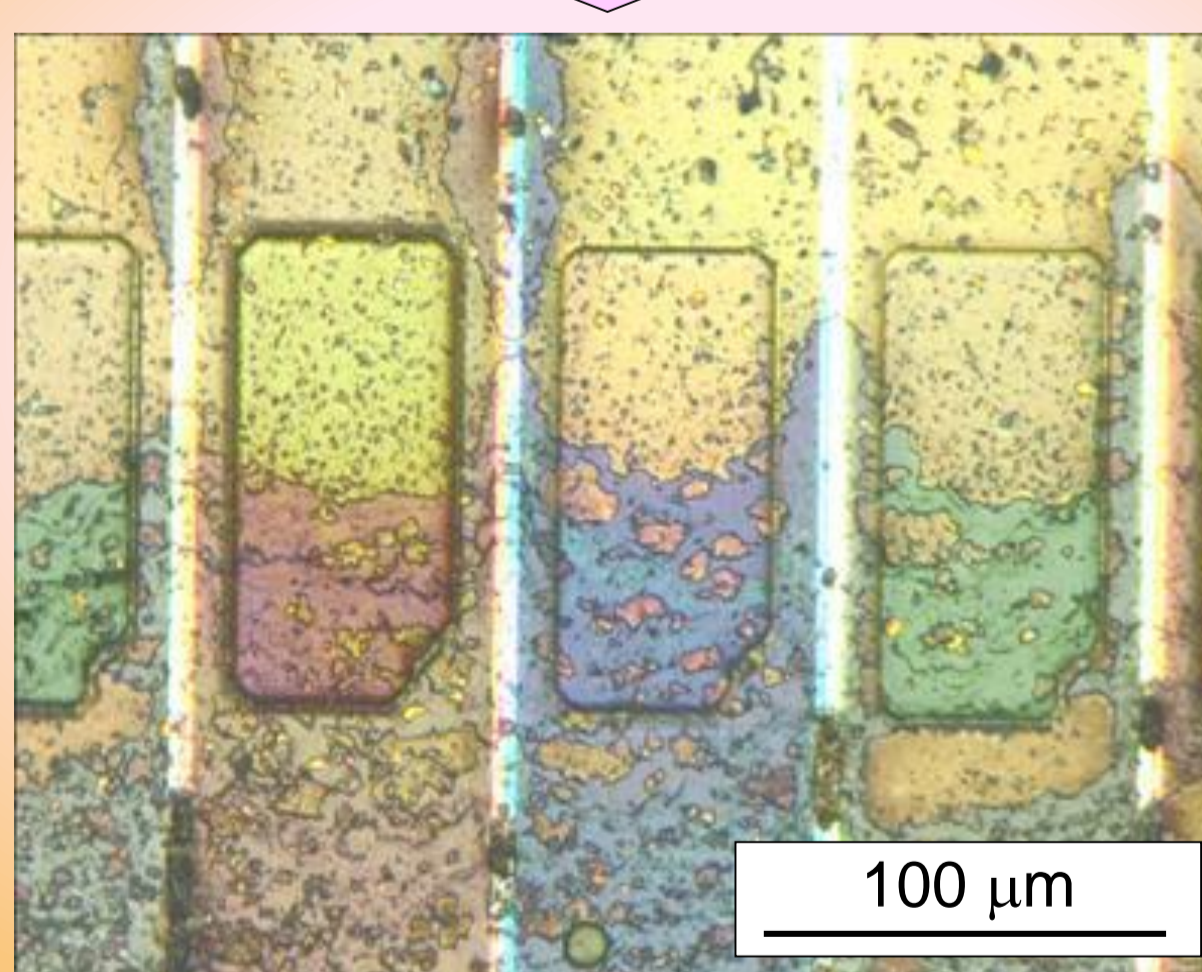


Glow Discharge

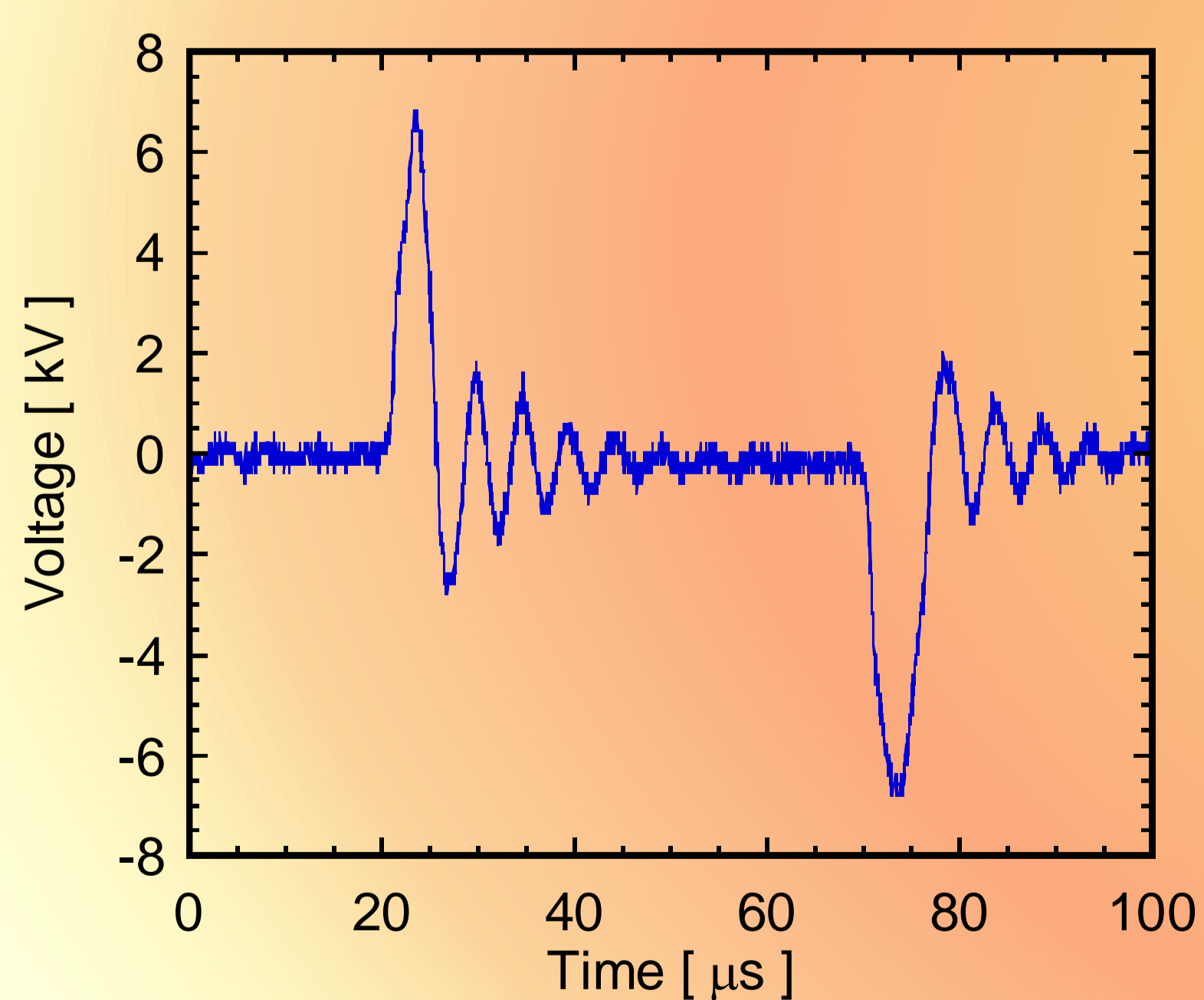
Indium Recovery from Liquid Crystal Panel by Non-Thermal Plasmas



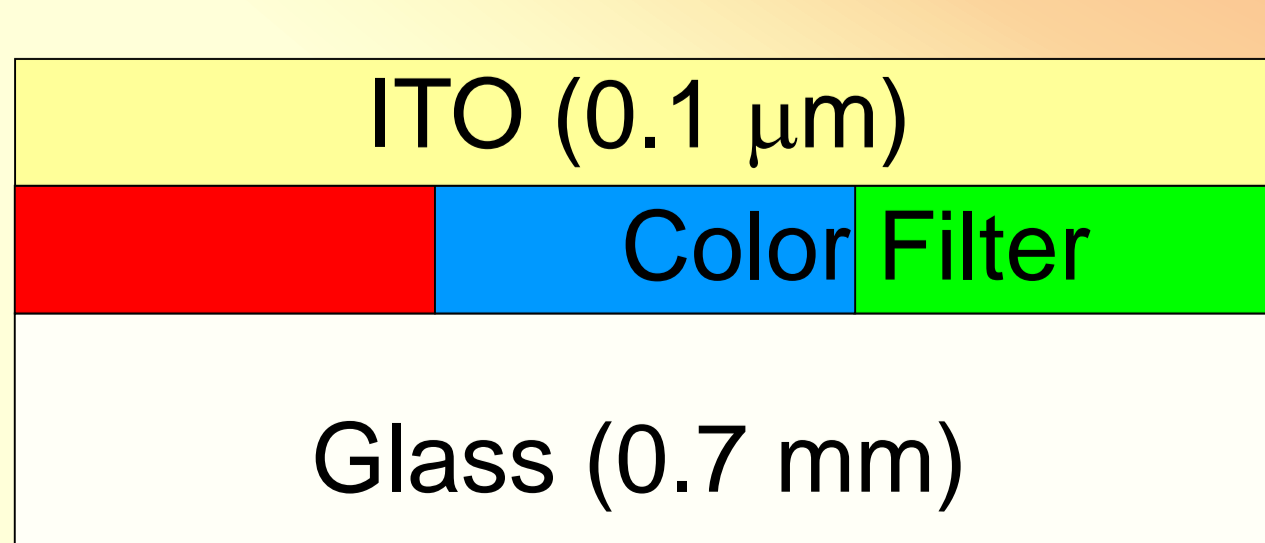
Plasma Treatment



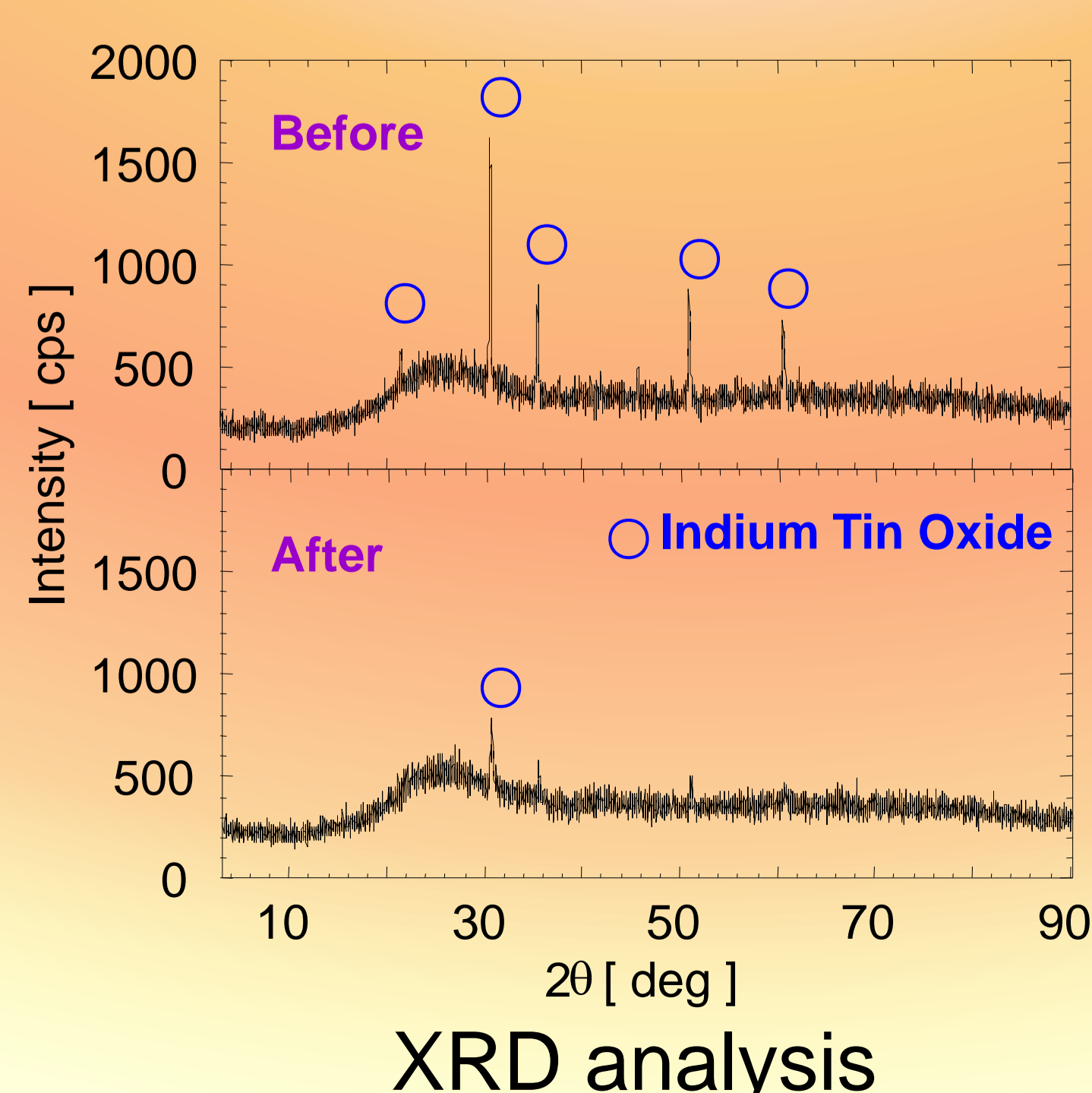
In removal efficiency from ITO panel by non-thermal plasma



Voltage form of power supply for non-thermal plasma generation



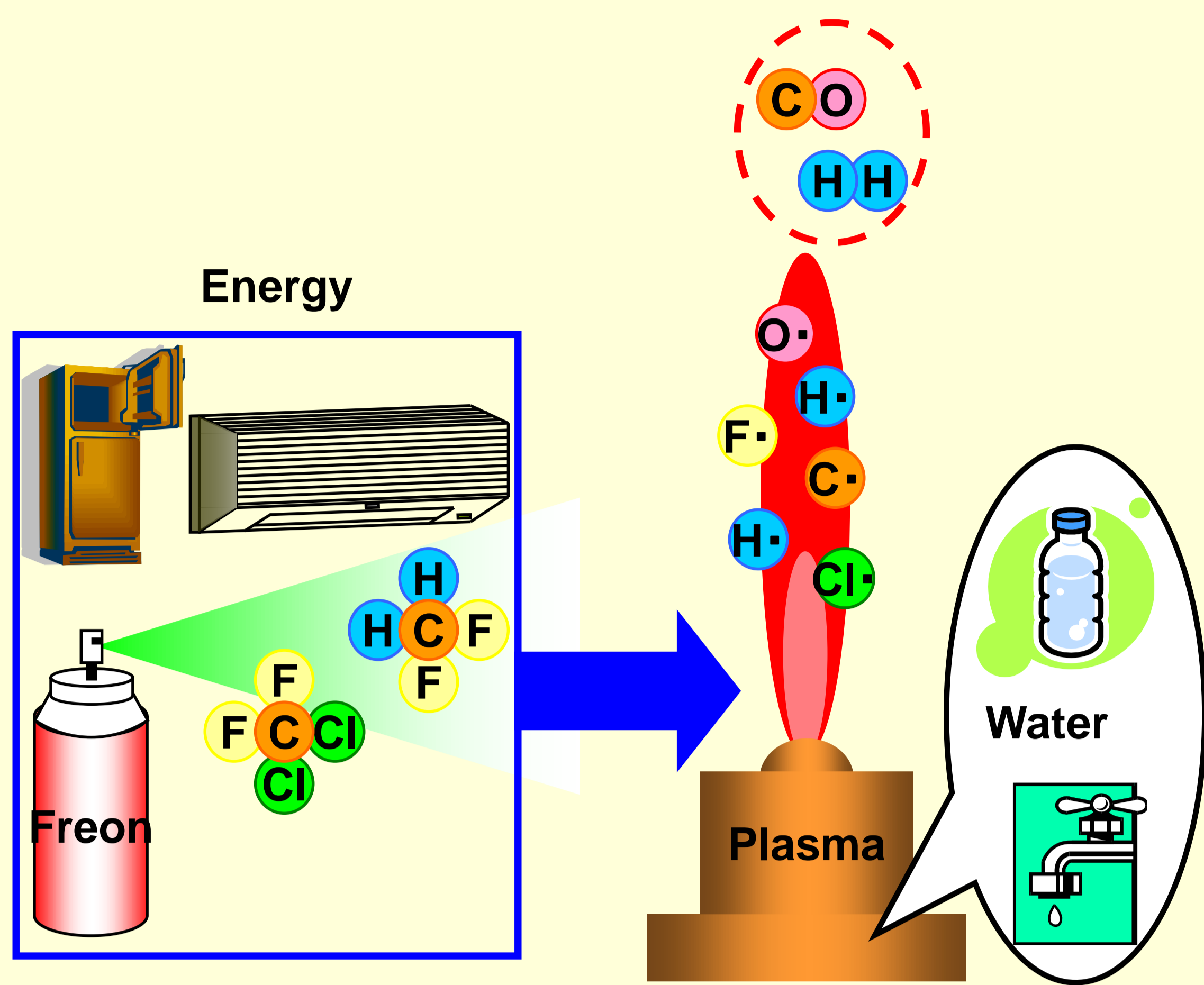
Color Filter Configuration



- Removal rate at 79% from ITO panel was obtained by atmospheric plasmas using air within 1 min.
- Indium and Tin were removed simultaneously using atmospheric plasmas.



CFC, HFC, PFC Destruction by Water Plasmas

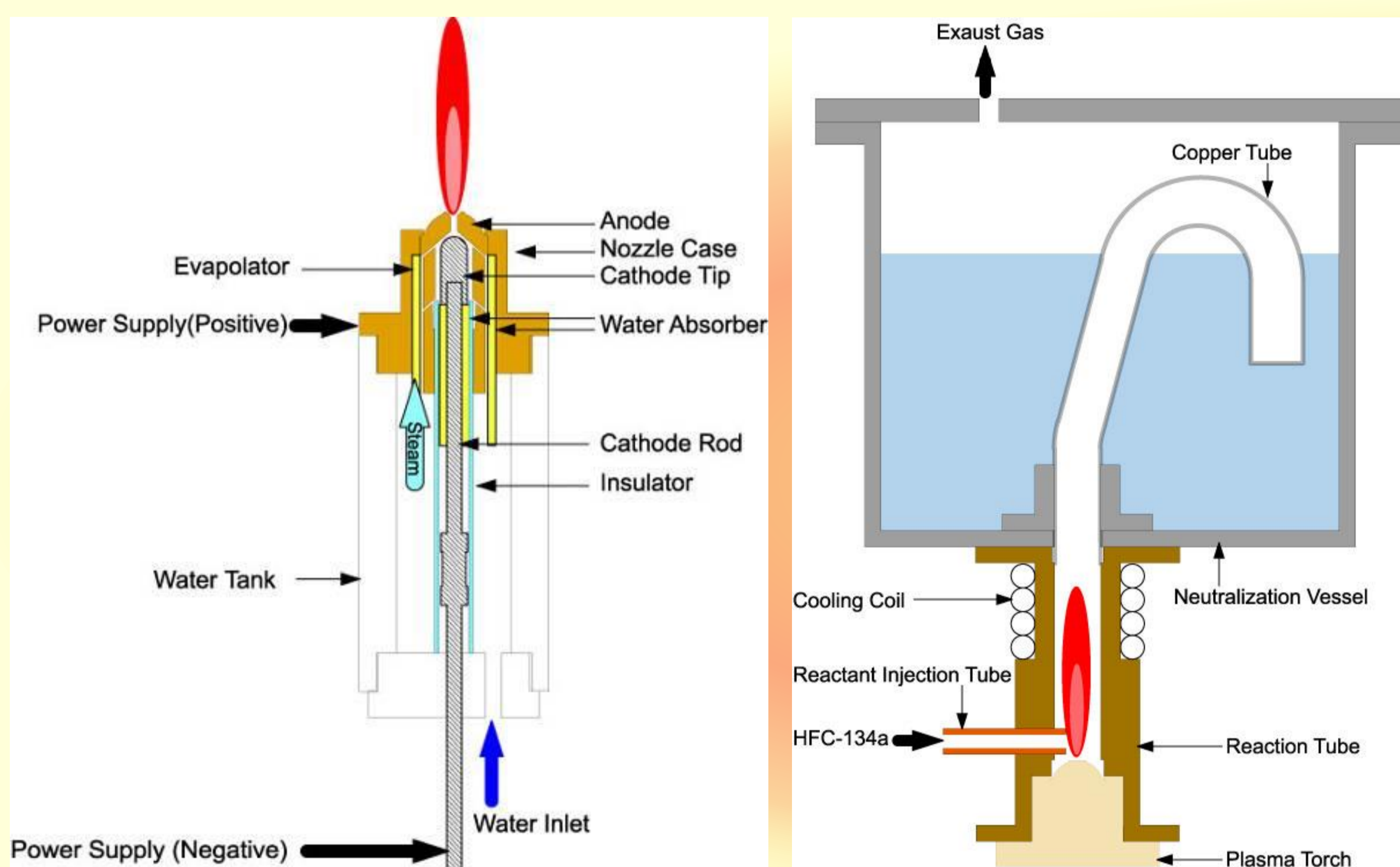


Mechanism

1. Arc generation
2. Heat conduction to water through copper anode
3. Plasma gas directly supplied from cooling water

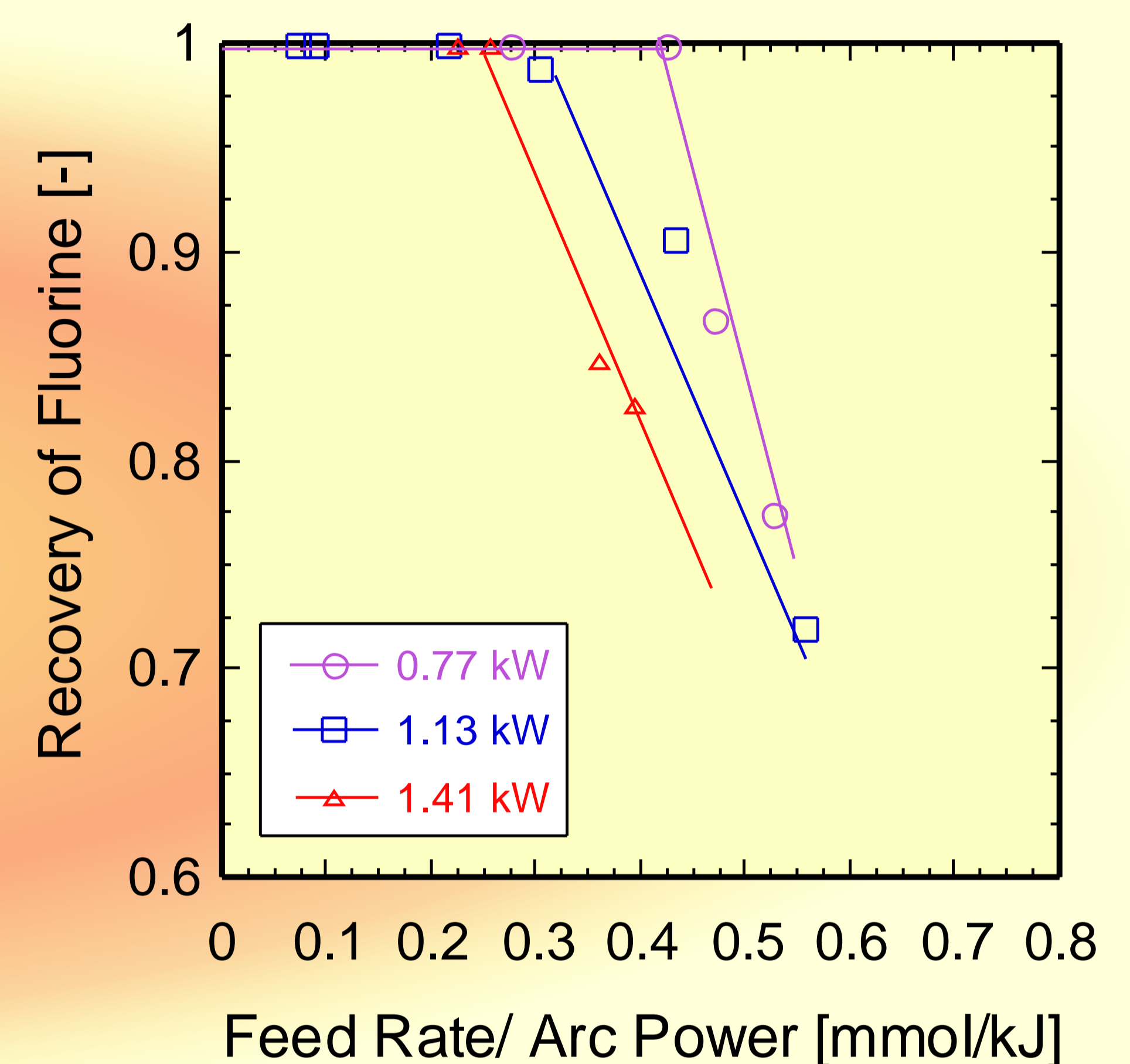
Advantages

1. 100%-steam plasma generation
2. Portable light-weight plasma system
3. No additional water-cooling
4. No gas supply



Water plasma reactor for HFC, CFC destruction

Pressure: 101 kPa
 Decomposition Time: 6 min
 Arc Power: 0.65-1.47 kW
 Arc Current: 4.0-7.0 A
 Water Supply: 325 mmol/min
 HFC134a: 5-185 mmol/min



Fluorine recovery (indicating HFC destruction)

Vehicle Mounted Water Plasma System for Waste Treatment



- Plasma generation: air under 1-atm, Power: 220 kVA
- CFC, HFC, PCB, Asbestos are possible waste material to be decomposed.

- Decomposition of HFC-134a was performed by water plasma system.
- Decomposition of 99.9% can be obtained up to 0.43 mmol/kJ (maximum feed rate is 160 g/h at 1 kW).

Conclusion

- Required research for attractive waste treatment
 - ✓ Reaction mechanism in the plasmas
 - ✓ Sophisticated numerical analysis (including chemical reactions)
 - ✓ Control of plasma reactivity
- There are numerous reactor designs for treatment of all types of wastes
- Economics is principal issue
- Economics improved if saleable co-product can be generated