Waste Treatment by Atmospheric Pressure Plasmas

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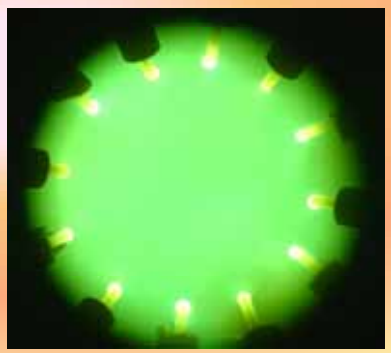
- High enthalpy to enhance reaction kinetics
- High chemical reactivity
- Oxidation and reduction atmospheres
- Rapid quenching (10^6 K/s)

Atmospheric Plasma

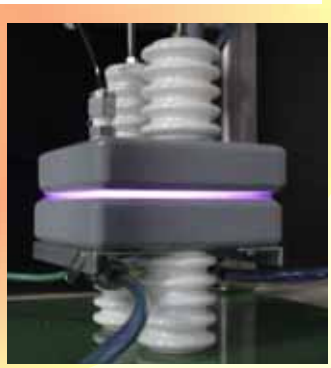
- Low-Level Radioactive Waste
- Ion-Exchange Resin
- Municipal Waste
- Incinerated Ash
- Fly Ash from Melting Furnace
- Gasification

RF Plasma

DC Plasma

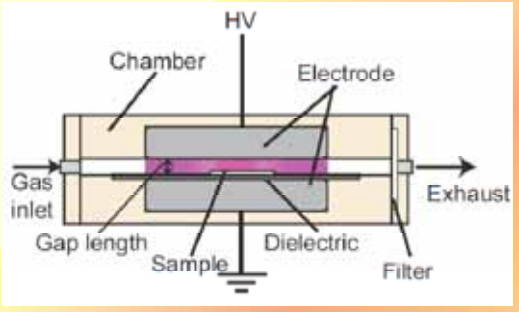


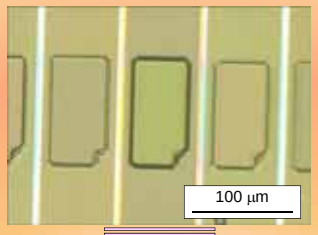
Multi-phase Arc



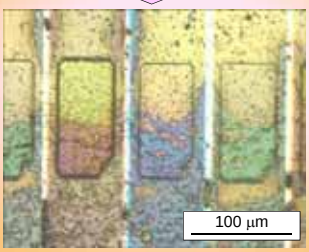
Glow Discharge

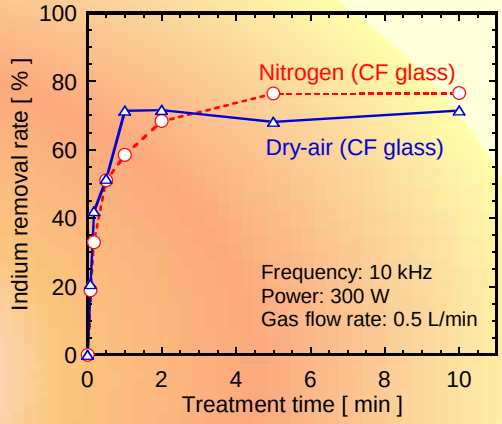
Indium Recovery from Liquid Crystal Panel by Non-Thermal Plasmas



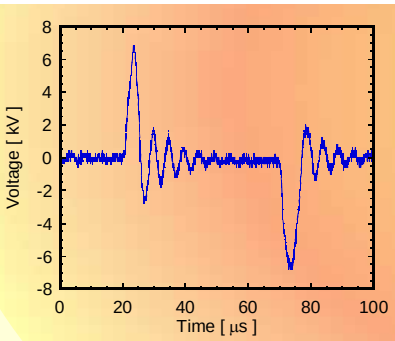


Plasma Treatment

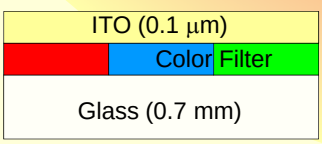




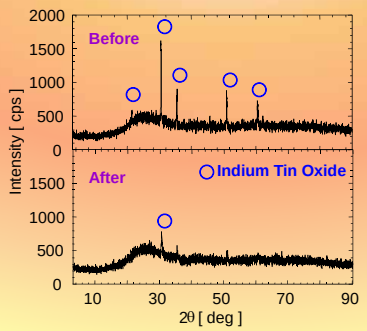
In removal efficiency from ITO panel by non-thermal plasma



Voltage form of power supply for non-thermal plasma generation



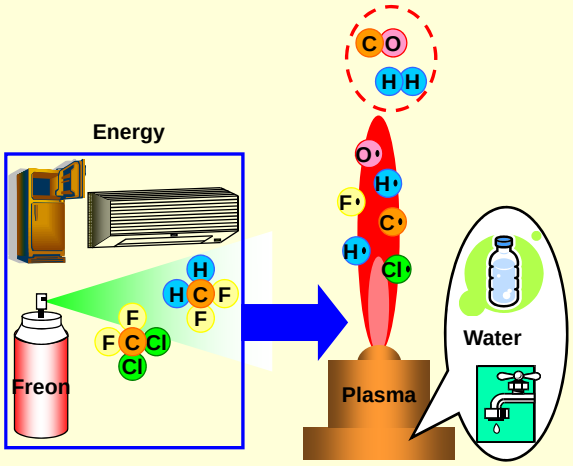
Color Filter Configuration



XRD analysis

- 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

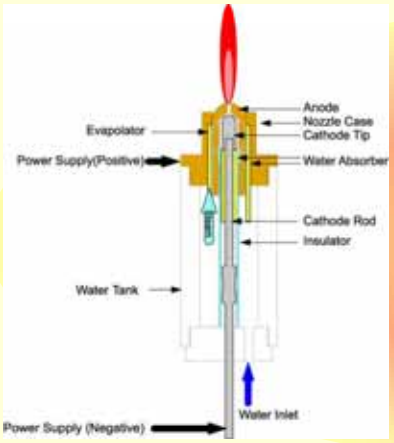


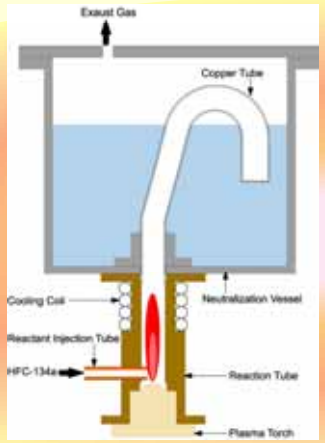
Mechanism

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

Advantages

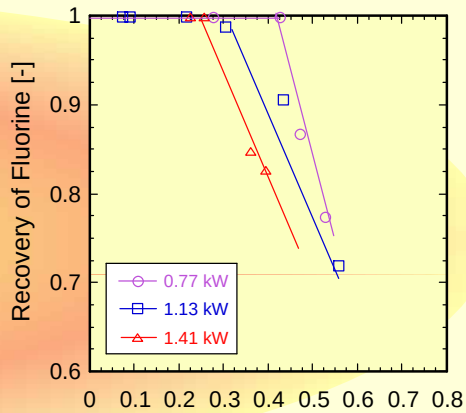
1.100%-steam plasma generation
2.Portable light-weight plasma system
3.No additional water-cooling
4.No gas supply





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-atom, 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