Decontamination of Tritium from exhaust gas of IECF device

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Motivation

Inertial Electrostatic Confinement Fusion (IECF) has produced neutron by using D-D reaction. However, D-D reaction has not enough neutron production rate for applications. To improve this point, using D-T reaction which can produce 200 times as much neutron than D-D reaction is planned at the experiment.

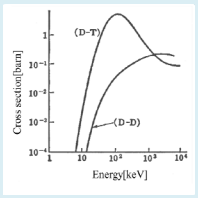


Fig.1. Reaction cross section

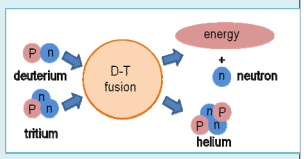


Fig.2. D-T reaction

IECF device for D-T burning

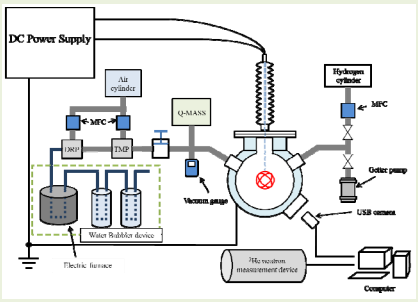


Fig.3. Schematic diagram of IECF

Fig.4. Cathode

Fig.5. Vacuum chamber

Fig.6. Getter material

Fig.7. DC power supply (125kV, 80mA)

- Vacuum chamber with water jacket (inner radius 25cm, outer radius 30cm)
- 6rings Cathode made of **molybdenum** (inner radius 55mm, outer radius 65mm)
- ^{3}He neutron counter calibrated by **AmBe**

Results

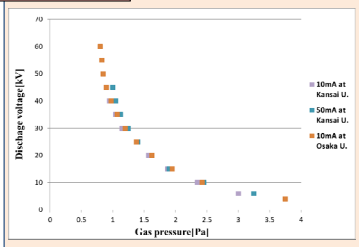


Fig.8. Discharge characteristic with D_2 gas

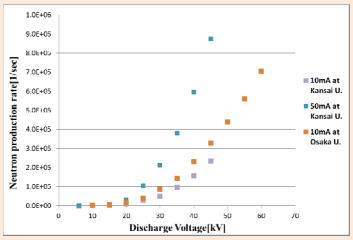


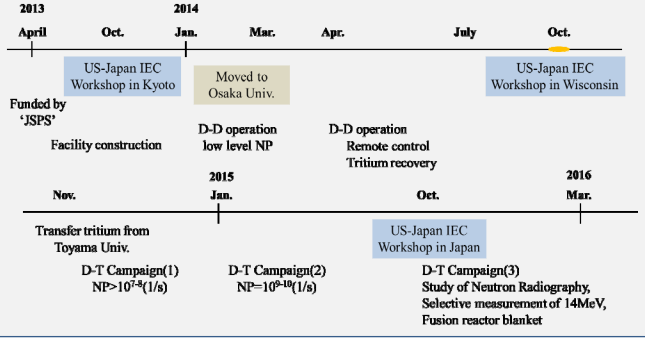
Fig.9.Neutron production rate with D_2 gas

These experiments are the pretests before D-T burning at Osaka U.. (with 100% deuterium gas, dry pump and TPM for clean-up of the inner wall of vacuum chamber)

Tab.1. Result of the experiment

	Discharge current [mA]	Discharge voltage [kV]	Neutron production rate [1/sec]
Kansai U.	10	45	2.3×10^5
Kansai U.	50	45	8.8×10^5
Osaka U.	10	60	7.0×10^5

Time Schedule



Tritium handling

Decontamination of Tritium

Water Bubbling Recovery

In order to prevent the release of tritium gas, tritium gas must be decontaminated.

After the experiment, 99% tritium gas is recovered by getter material.
Next, residual tritium gas in the vacuum chamber is evacuated by hydrogen discharge.

Exhaust tritium gas becomes tritium water on the surface of heated CuO(Ⅱ).

$$DT + CuO \rightarrow DTO + Cu$$
$$T_2 + CuO \rightarrow T_2O + Cu$$

Result of the experiment (Fig.17), H_2 is decontaminated **99.95%** in more than 300℃ by this device.

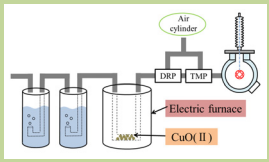


Fig.15. Schematic diagram of Water Bubbling Recovery

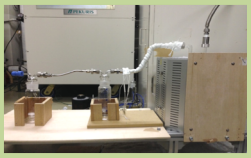


Fig.16. Water Bubbling Recovery device

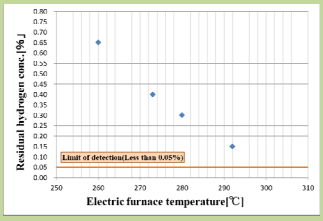


Fig.17. Water Bubbling Recovery experiment

Sub-critical assembly building at Osaka U.

- Using tritium is recognized in the Heavy irradiation room.
- Possible to shield 14MeV neutron.

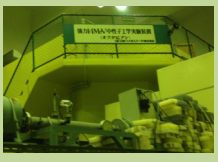


Fig.10. Outer wall of the Heavy irradiation room

Fig.11. IECF device in the Heavy irradiation room

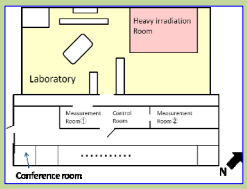


Fig12. Sketch of sub-critical assembly building

Fig.13. DC power supply

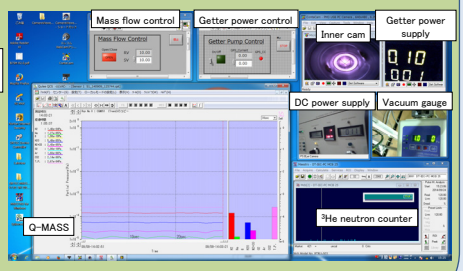


Fig.14. Remote control screen