20PB-077

D-T burning with IEC Fusion device

IECにおけるD-T燃焼実験

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Conventionally, Inertial Electrostatic Confinement(IEC) fusion device produces neutron by using the D-D reaction. However, the neutron production rate by D-D reaction is not enough. Using D-T reaction, a large quantity of neutrons will be supplied because that the cross-section of D-T reaction is about 200 times larger than one of D-D reaction. The goal of this study is to product 10^9/sec neutrons by D-T reaction with safely operation of treatment radioactive tritium.

1. Inertial Electrostatic Confinement (IEC) fusion

Figure 1 show that the spherical anode and ring cathode are placed concentrically. The applied voltage between the electrodes is almost 30 - 60 kV. Part of deuterium neutral gas is ionized, ion is accelerated toward the cathode, and electron is accelerated toward the anode respectively. High energy ion collide with neutral gas near the cathode, the neutron is produced by the nuclear fusion.

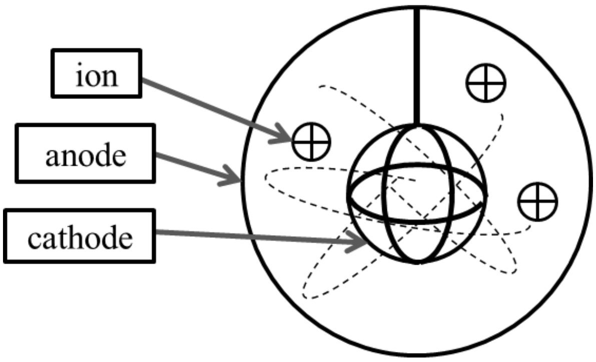

Figure.1 Principle of IEC

2. Experimental setup

IEC device consists of spherical vacuum chamber serves as anode, molybdenum cathode, turbo molecular pump and dry pump. Figure 1 is schematic figures of IEC device, the vacuum meter and quadrupole mass spectrometer (Figure.2). The production rate of neutron at 6.8 x 10^6[n/s] is achieved by using deuterium gas only (Figure.3). Using tritium gas, the rate will be increased 200 times. The neutron beam shielding structure and the facility for tritium handling are required. Therefore, this study is experimented in OKTAVIAN at Osaka U. OKTAVIAN is the facility that can shield 14MeV neutron. Using of tritium is experimented in heavy irradiation room.

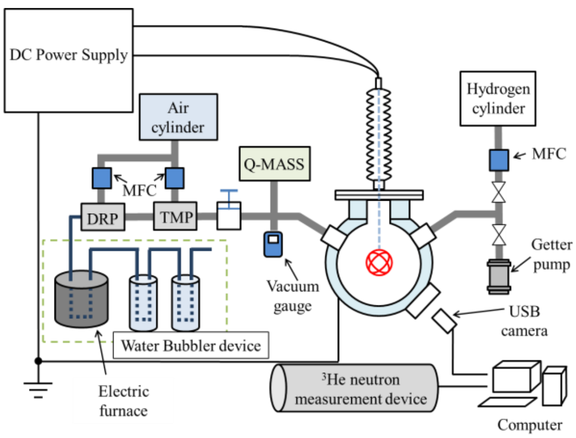

Figure.2 Experimental device

3. Water bubbler system

Tritium recovering system is required to prevent from releasing tritium gas into the air. In this study, water bubbler system is used for recovery tritium (Figure.4). Tritium gas which is exhausted from the dry pump with purge gas flows to the pipe in the electric furnace. Tritium gas becomes tritium water by heating up to 350°C on the surface of copper oxide in the electric furnace. Tritium vapor is melted into water at the water bubbler container.The density. The concentration of tritium in the water is mesured by liquid scintillation.

According to the previous exmerimental results of the similar system, 99.9% of tritium is recovered in the water bubbler container. In this study, the residual level of tritium is researched with this water bubbler system. The result of mesurement shows that hydrogen gas (which is substitute for tritium gas) density is lower than 0.05% in the exhaust gas at 300℃(Figure.5).

3. Future plan

This water bubbler system will install the IECF device for tritium experiment. The recovery test with deuterium gas will be executed. The neutron production experiment by the tritium – deuterium fusion is planned in next January.

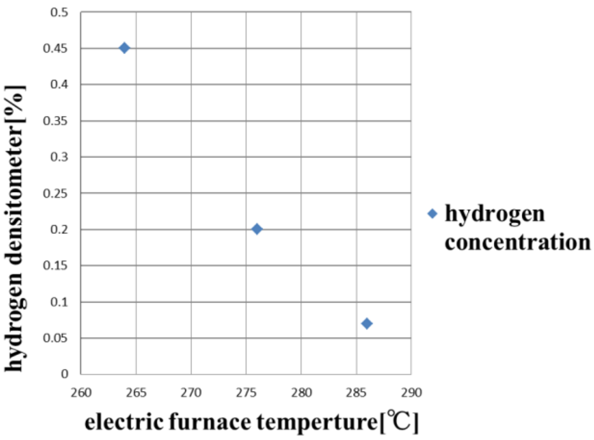

Figure.5 water bubbling Recovery experiment

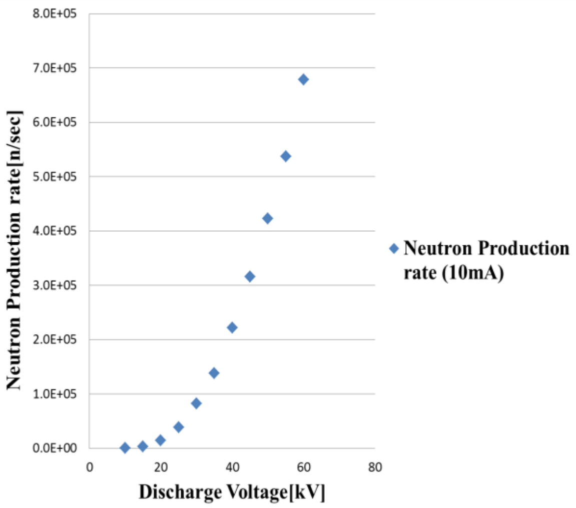

Figure.3 Neutron production rate with D_2 gas

Figure.6 Photo of discharge

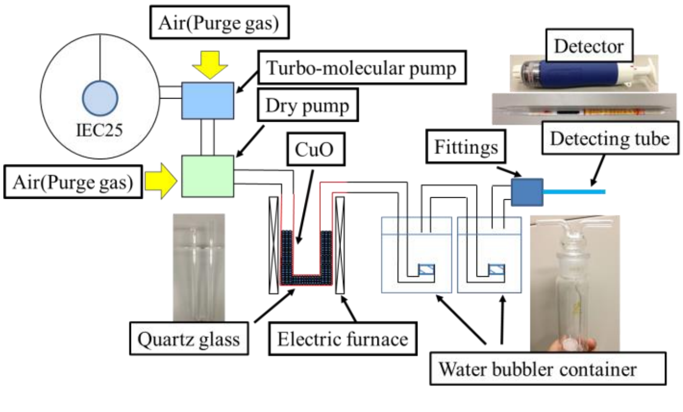

Figure.4 water bubbler system