D-T Burning in IECF

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Osaka University, Graduate School of Engineering

US-Japan IEC Workshop
Oct.1-2, 2014
University of Wisconsin
INTRODUCTION

The D-T burning project has been funded by JSPS KAKENHI (Grant Number 25289340) for three years from April, 2013 to March 2016.

The present study and progress after the last workshop is reviewed.

The project is organized by seven universities.
<table>
<thead>
<tr>
<th>Institution</th>
<th>Main Tasks</th>
<th>Collaborators</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Kansai Univ. Faculty of Engineering Science</td>
<td>Supervision IEC construction and experiment</td>
<td>M. Ohnishi, Y. Yamamoto, H. Osawa</td>
</tr>
<tr>
<td>(2) Kyoto Univ. IAE</td>
<td>Design and manufacture of the IEC device</td>
<td>K. Masuda</td>
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<td>(3) Kyoto Univ. RRI</td>
<td>Measurement of 14 MeV neutrons</td>
<td>T. Misawa</td>
</tr>
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<td>(4) Osaka Univ. Subcritical Assembly Laboratory</td>
<td>Host of Exp. site and safety issue</td>
<td>I. Murata</td>
</tr>
<tr>
<td>(5) Toyama Univ. Hydrogen Isotope Research Center</td>
<td>Tritium handling and supply of Tritium</td>
<td>Y. Hatano</td>
</tr>
<tr>
<td>(6) Tokyo Institute of Technology</td>
<td>Control and operation of closed device</td>
<td>E. Hotta</td>
</tr>
<tr>
<td>(7) Kyushu Univ.</td>
<td>Adviser</td>
<td>M. Nishikawa</td>
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Time Schedule (delayed)

2013
- April
- Oct.
  - US-Japan IEC Workshop In Kyoto

2014
- Jan.
- Mar.
- Apr.
- July
- Oct.
  - D-D operation
    - low level NP
  - D-D operation
    - Remote control
    - Tritium recovery

2015
- Nov.
- Jan.
  - Transfer tritium from Toyama
  - D-T Campaign (1)
    - NP<10^7−8 (1/s)
  - D-T Campaign (2)
    - NP=10^9−10 (1/s)

2016
- Oct.
- Mar.
  - US-Japan IEC Workshop in Japan
  - D-T Campaign (3)
    - Studies of Neutron Radiography,
      Selective measurement of 14MeV neutrons,
      Fusion reactor blanket

- Moved to Osaka Univ.
- Funded by ‘JSPS’
## Difference between D-D and D-T experiments

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<tr>
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<th>D-D</th>
<th>D-T</th>
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<tbody>
<tr>
<td>Neutron Production (1/s)</td>
<td>$&lt; 10^7$</td>
<td>$&gt; 10^9$</td>
</tr>
<tr>
<td>Neutron Energy</td>
<td>2.45 MeV</td>
<td>14.1 MeV</td>
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</table>

> Thicker concrete wall for shielding

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<tr>
<th>Tritium Safety</th>
<th>Open to the air</th>
<th>Closed against the environment</th>
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<tr>
<td>Tritium recovery after shut down</td>
<td>-</td>
<td>Recovery of gaseous tritium (water bubbler)</td>
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</table>

> The facility must meet the strict regulation for the tritium safety. A gaseous tritium larger than 70 Bq/cc cannot be released to the air. A monitoring system for the tritium should be equipped.
Drawing of the IEC device for D-T burning
Photo of D-T IECF in the heavy irradiation laboratory
(1) Y. Yamamoto, et al., “Prepare for the D-T Burning in IECF”

Relocation and modification of the device, remote operation system, and the tritium handling system using getter pump


Characteristics of feeding the hydrogen isotope into the vacuum chamber by getter pump. The getter pump absorbs 99% of the D-T gas in vacuum chamber.
Neutron Production by D-D Gas

Voltage (kV)

Neutron Production rate (1/s)

Osaka Univ.
Kansai Univ.

10mA
Gas pressure control by getter pump
(3) K. Miyamoto, et al., ”Decontamination of Tritium from exhaust gas of IECF device”

The residual tritium gas in the vacuum chamber after the getter pumping is removed by the oxidization with CuO and the water bubbler. The gaseous tritium can be much less than 70 Bq/cc in the exhaust gas.
Issues for D-T burning

- Gas pressure setting by getter pump needs the precise control of the temperature of the getter material.
- The D-T mixture control should be required. But, the release of the gas from the getter material depends upon the each pressure of the hydrogen isotopes in the chamber.
The other activities in the Kansai University:


(5) Y. Kawahira, et al., “Discharge characteristics of multiple IEC device”