DEVELOPMENT OF A NEW CONCEPT ION SOURCE FOR HIGH PERFORMANCE INERTIAL ELECTROSTATIC CONFINEMENT FUSION DEVICE

Yasuyuki Taniuchi, Yoshihito Matsumura, Katsuyoshi Taira and Michiaki Utsumi*
Graduate School of Science and Technology, Tokai University, Kitakaname 1117, Hiratsuka 259-1292, Japan

An Inertial Electrostatic Confinement Fusion (IECF) is a concept [1]-[2] for retaining a plasma using an electrostatic potential well. It consists of two spherical grids inside the vacuum chamber. An insulated high v oltage feed-through supplies power to the inner grid cathode, and a small amount of deuterium or tritium gas (0.1-1.0 Pa) is fed into the chamber. When the voltage is applied to the inner grid, the background gas is ionized by ion and electron impact. The generated ions are oscillated by the potential difference between the spherical grids. MeV-order protons and neutrons are produced by the fusion interaction that mainly results from beam-background and fast neutral-background interactions.

The birth position of the ions is key factor in order to achieve the high Neutron Production Rate (NPR). The ions are generated near the outer grid anode, where the electrostatic potential is large, and effect of the distortion of the electric equi-potential surface due to inner grid wire and feed-through on the ion trajectory is small. On the other hand, the ions are generated near the inner grid where there is a small electric potential accelerating it towards the center of the sphere. In addition, the effect of the distortion of that is large, so they may be attracted by the inner grid wires. From above reasons, it is desired that many ions are generated near the outer grid. However, in the glow discharge type IECF device, the ions are generated at all range. If the ion source is equipped near the outer grid, the ions emitted from the ion source to inner grid can obtain the higher kinetic energy. Although there are Induction Coupled Plasma, Electron Cyclotron Resonance and Helicon plasma ion source as the typical ion source, which are costly and complex structure. So we are developing the economical and simple structure ion source, which can obtain the high ion current density at low gas pressure. As the arrangement of the IECF device, this ion source consists of two spherical electrodes. However, the positive bias is applied to the inner spherical grid. The electrons are oscillated between the electrodes and ionize the background gas. It seems that the NPR of the IECF device is increased by using this ion source. We will show the experimental results of measured NPR that are carried out by using this ion source.

1. P.T. Farnsworth, “Space Charge Device for Producing Nuclear Reactions,” *Canadian Patent*, **654**, 306, 1962.
2. R. L. Hirsh, “Inertial-Electrostatic Confinement Ionized Fusion Gases,” *J. Appl. Phys*, **38**, 4522, 1967.