§20. Basic Study of Direct Energy Conversion for D^3He/FRC Fusion Reactors

Ishikawa, M. (Inst. Eng. Mech. & Systems, Univ. Tsukuba)
Namba, C., Tomita, Y., Momota, H.

I. Objectives

The objectives are to study direct energy converters applied for D^3He/FRC fusion reactors with numerical analyses, to reveal items to be solved, to carry out preliminary and conceptual designs of the CUSP type DEC and TW type DEC, and to organize international cooperation. The CUSPDEC is supposed to separate the ions and electrons and also convert their kinetic energy into electricity, whereas the TWDEC will convert the kinetic energy of protons produced by the fusion reaction.

II. Cooperative Studies

The members of present cooperation research program have carried out independently their own research at their institutes and had intensive discussion at seminars held at NIFS. They also joined the US-Japan workshop and played important roles.

2.1 Seminar on May 20th

Attendees: M. Ishikawa, C. Namba, H. Momota, Y. Tomita, Y. Yasaka (Associate Professor of Kyoto Univ.), and Y. Shimizu (Ms Student of Kyoto Univ.)

2.2 Seminar on July 21st

Attendees: M. Ishikawa, C. Namba, H. Momota, Y. Tomita, and Y. Shimizu (Ms Student of Kyoto Univ.)

2.3 US-Japan Workshop on Physics of High-Beta Plasma Confinement in Innovative Fusion on December 14th and 15th

Attendees: M. Ishikawa, C. Namba, H. Momota, Y. Tomita, Y. Shimizu (Ms Student of Kyoto Univ.), S. Mima (Ms Student of Kyoto Univ.), and many others

III. Results Obtained by the Studies

3.1 Behavior of CUSPDEC

Many sets of magnetic field distribution for CUSPDEC are compared, which are designed with three-dimensional analyses of magnetic field. Trajectories of deuterium ions and others are obtained with time-dependent two-dimensional calculations which take into account effects of space charge distribution. It is found that the electric field generated by ions has very large effects.

3.2 Behavior of TWDEC

We have designed an external electric circuit which can induce the travelling wave by the interaction with the ion flow, and developed a time dependent one-dimensional numerical scheme which can simultaneously analyze the external circuit, the ion trajectory, and the potential distribution. We have also developed a time dependent two-dimensional code, and analyzed the behavior of TWDEC with consideration of collision of ions with grids. It has been found that the collision loss with grids is much larger than the pure two-dimensional losses.

3.3 Publications

1. Ishikawa, M., Kudo, T., Hayashi, S. Yamane, T., Tomita, H. and Momota, H., "Basic Numerical Simulation on TWDEC for a D-3He Fusion Reactor", Fusion Engineering and Design **41**, (1998)541
2. Ishikawa, M., Kudo, T., Yamane, T., Hayashi, S., Shimizu, Y., Tomita, Y. and Momota, H., "Loss Estimation of TWDEC for a D-3He FRC Fusion Reactor", Workshop on Physics of High Beta Plasma Confinement in Innovative Fusion, (1998) No.6