

§10. Research on mm and Sub-mm Wave Technology and Applications

Ando, A. (Graduate School of Engineering, Tohoku Univ.), Shimozuma, T.

1. Objectives

A lot of RF(Radio Frequency) technologies from millimeter to sub-millimeter wave range have been utilized for plasma heating, current drive, plasma control and advanced plasma diagnostic methods in the nuclear fusion research. On the other side, applications of the electromagnetic waves in this wavelength regime expand to many fields. In National Institute for Fusion Science, there are lots of millimeter wave devices such as gyrotrons, transmission lines and millimeter wave detectors for plasma experiments. The millimeter wave power is utilized for not only plasma heating, but also for electron temperature measurement through the electron cyclotron emission from the plasmas. Since the millimeter wave technology, which includes power sources, detectors and components, is still developing, it is important to catch up with the leading edge of such technology for the improvement of ECH and ECE system. The objectives of this workshop are the information exchange among the researchers of millimeter and sub-millimeter wave and microwave technologies, the improvement of each millimeter wave systems and development of combined research fields.

2. Activities in FY2007

The activity of this fiscal year was to research applications of millimeter and sub-millimeter wave technologies. Researchers on the different fields attended on the workshop under the keyword of "mm and sub-mm wave technologies"

Main subjects dealt with were

1. Millimeter wave technologies related with nuclear fusion research. The latest results on LHD and ITER ECH technologies.
2. Power sources in the millimeter and sub-millimeter wave ranges and their applications to non-fusion research fields.

Related with the first item, Dr. A. Kasugai (JAEA) made a presentation of "Development of a 1MW-CW gyrotron for ITER". He showed the recent development of high power gyrotrons and their technological aspects. As for the second item, Dr. S. Mitsudo (Univ. of Fukui) talked the application of high power Tera-Hertz waves to the material sciences.

Program and contents of the lectures are as follows.

(1) "Development of a 1MW-CW gyrotron for ITER" by Dr. Atsushi Kasugai (JAEA)

ECH, ECCD and NTM suppression by their application are planned in the ITER project. JAEA achieved full specification of a gyrotron required by ITER, which is 1MW output, 800 sec duration and oscillation efficiency of 55% simultaneously. The high efficiency operation was successfully obtained by moving the operation region to the hard-excitation region during the pulse.

(2) "Application of high power Tera-Hertz waves to the material sciences" by Dr. Seitaro Mitsudo (Univ. Fukui).

Recently high power Tera-Hertz sources (several kilo-Watts) are realized by the development of high frequency gyrotrons. In Research Center for Development of Far-Infrared Region, University of Fukui, they have been developing high power and high frequency gyrotrons and researching their application to many fields. Among these, he explained the measurement methods of material characteristics by using NMR (high frequency electron spin echo, dynamic nuclear polarization NMR and magneto resonance force microscope), and also the application of Tera-Hertz waves for material heating to produce new materials.

Twenty members joined the workshop. All of those are distributed over wide research areas related to the millimeter and sub-millimeter wave technology. In this year, as many participants as possible were asked to make presentations to report their recent activities. The presenters and their presentation titles are following,

- "Development of EC launchers for JT-60SA and ITER" by Dr. T. Kobayashi (JAEA).
- "Generation of Tera-Hertz waves through the interaction between femto-sec Laser and plasmas" by Dr. N. Yugami (Utsunomiya Univ.).
- "Research of microwave heating by evanescent waves" by Dr. M. Saigusa (Ibaragi Univ.).
- "Utilization of a Vlasov antenna in the long wavelength regime and evaluation of its conversion loss" by Mr. T. Kurihara and Dr. R. Ando (Kanazawa Univ.).

The viewgraphs of each lecture were summarized in the CD-ROM for convenience.