



IAEA FEC 2011

Contribution ID: 416

Type: Poster

## Design Development of the ITER Divertor Diagnostic Systems in Japan

Wednesday 19 October 2016 14:00 (4h 45m)

Advanced design for Divertor Impurity Monitor (DIM) and IR Thermography (IRTh) is being developed in Japan to contribute to the divertor plasma control and research in ITER through the spectroscopic measurement with high spatial and spectral resolutions and accurate measurement of the target temperature.

DIM spectroscopically (200 nm –1000 nm) measures two dimensional profiles of the emissions from metallic impurities (such as W, Be), injected impurity gas (Ar, Ne, Kr), fuel ions, helium in the divertor plasma. The DIM optical system consists of the upper port #1 system, the equatorial port #1 system and three optical systems in the lower port #2. The dome optics is expected to resolve the ionization and recombination of fuel ions to characterize the plasma detachment at the strike points with 20 mm resolution. Both the optical performance and neutron shielding performance is satisfied by labyrinth of optical path and non-spherical mirrors in the front end optics. In the upper port #1 system, for example, the first mirror (M1) is inclined 45 degrees to enable the mirror cleaning discharge in the stationary toroidal field. The relay optics consists of six mirrors and two groups of chromatic corrections lenses. This optics also has a function of optical axis alignment, so that the light flux is focused to multi-channel fibers by Cassegrain imaging optics in the port cell. UV light is measured by UV spectrometers in the port cell and visible light is transferred to the diagnostics room and is measured by visible spectrometers.

IR Thermography (IRTh) is required to measure the target temperature of 200 –1000 °C with the time resolution of 2 ms and that of 1000 –3600 °C with the time resolution of 20 μs with the spatial resolution of 3 mm. Laboratory experiments were carried out to investigate characteristics of W samples for IRTh. It was found; (i) Emissivity  $\epsilon$  of the W sample increased from 0.2 to 0.6 when the surface roughness changed from 0.3 μm to 5.9 μm. (ii) Back scattering of IR laser ( $\lambda_{IR} = 3.22 \mu\text{m}$ ) on W samples was observable in the range of viewing angle by IRTh, if the surface roughness is 1 μm or larger than 1 μm. (iii) The formula,  $\epsilon(\lambda_{IR}) = 1 - f(\lambda_{IR})$ , where  $f$  is reflectivity, was experimentally validated. Therefore, feasibility of in-situ calibration of by using IR laser light was demonstrated for the first time.

### Country or International Organization

Japan

### Paper Number

FIP/P4-8

**Author:** Dr ITAMI, Kiyoshi (Japan Atomic Energy Agency)

**Co-authors:** Dr VESHCHEV, Evgeny (ITER Organization); Dr OGAWA, Hiroaki (Japan Atomic Energy Agency); Dr TAKEUCHI, Masaki (Japan Atomic Energy Agency); Dr WALSH, Michael (ITER Organization); Dr ANDREW, Philip (ITER Organization); Dr KITAZAWA, Sin-iti (Japan Atomic Energy Agency); Dr SUGIE, Tatsuo (Japan

Atomic Energy Agency); Mr MARUYAMA, Toshiyuki (Japan Atomic Energy Agency); Dr KAWANO, Yasunori (Japan Atomic Energy Agency)

**Presenter:** Dr ITAMI, Kiyoshi (Japan Atomic Energy Agency)

**Session Classification:** Poster 4

**Track Classification:** FIP - Fusion Engineering, Integration and Power Plant Design