§10. Laser Thompson Scattering Measurement of High Density Plasma Produced by TPD-II

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i) Introduction

Reduction of reversed gas flow toward main plasma in a gas divertor is required to achieve both a low thermal load on a divertor plate and high magnetic confinement in the main plasma. In the divertor system proposed by us, a high vacuum region is placed between the divertor region and the edge plasma region[1]. In this paper, a plasma diagnostics method using laser Thompson scattering is investigated by using high density plasma produced by TPD-II and TPD-Sheet-II.

ii) Experimental apparatus

The helium plasma generated in a plasma source traveled through a measurement chamber, contacted with a divertor plate, and finally relaxed to neutral gasses. Electron density of the plasma was around $10^{19}m^{-3}$ depending on the discharge current. The SHG beam of Nd:YAG laser with the pulse energy of 400mJ, the wavelength of 532nm, and repetition frequency of 10Hz was used as a light source for exciting a plasma. Observation windows were located at the position 0.8m downstream of plasma flow direction from the anode electrode. Cross sectional view of the experimental region is shown in Fig.1.

A laser beam was incident from a side window along with the horizontal axis of a sheet plasma. Scattered light of the plasma was observed at the vertical axis. Scattered light was guided into a spectrophotometer through the optical window, lens, and optical fiber. A photo multiplier tube of Hamamatsu Photonics (R3896) was attached to the spectrophotometer of ISA with 1200 l/mm grating.

Baffle plates were used to reduce stray light. The baffle plate was consists of five pieces of anodized aluminum plates with small size of hole for transmission of the laser light beam. The baffle plates were located near the optical vacuum windows inside vacuum chamber. Signals of Thompson scattering light of the plasma were averaged over 1000 times using a Boxcar Integrator. Electron temperature was estimated from the full width at half maximum of the observed Thomson scattering spectra.

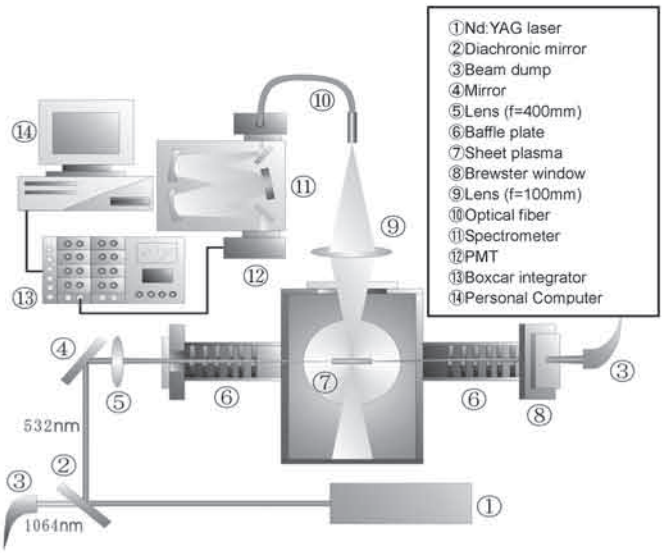

Fig. 1. Schematic diagram of the experimental region.

iii) Results and discussions

The intensity of stray and scattering lights at the experimental region without plasma was measured to estimate the performance of handmade baffle plates. As a result, it was found that the intensity of stray and scattering light can be reduced to one sixth compared with one without baffle plates.

The signal of Thomson scattering is calculated using the results from three different measurements for i.e. a laser light only, emission light of plasma, and the emission light of plasma with laser light. Experimental results were shown in Fig. 2. The similar value of the electron temperature calculated from the measurement of Thomson scattering were obtained corresponding to the values of a conventional single probe method. The electron temperature using the Thomson scattering will be measured for spatial distributions of sheet plasma as a function of the discharge current.

Reference

1) A. Matsubara et. al. J. Nuclear Material **337-339** (2005) 181.

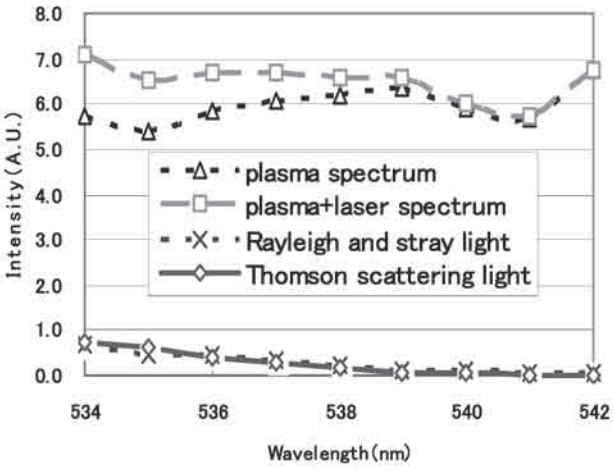

Fig. 2. Thomson scattering spectra of sheet plasma.