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Particle Reflection from Tungsten Surface Immersed in a Hydrogen Plasma

タングステン表面での水素プラズマイオンの反射特性

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The angular and energy distributions of hydrogen atoms released from tungsten surface due to hydrogen ion reflections are calculated by ACAT code, to evaluate the spectrum broadening of H_α. The result has shown a characteristic shape of line broadening distinctively different from the Gaussian velocity distribution. An experimental system is being arranged to observe the Doppler shifts of H_α line spectrum corresponding to the ACAT calculation conditions.

1. Introduction

Reflection of hydrogen atoms at tungsten surface should exhibit a peculiar characteristic showing a component of atoms reflected into the solid angle nearly parallel to the tungsten surface with little energy loss by collision. This component of reflected hydrogen can be measured by observing a Doppler shift of hydrogen line spectrum emission like H_α (656.28 nm). The line spectrum broadening of H_α due to impact of 200 eV proton has been calculated with ACAT (Atomic Collision in Amorphous Target) code and the result is shown in Fig. 1. The experimental arrangement to obtain spectroscopic data that can be compared with Fig. 1 is being assembled.

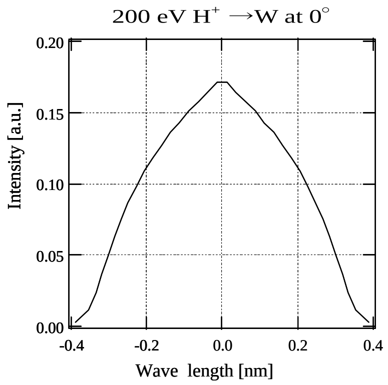

Fig. 1. Doppler shift of H_α from hydrogen atoms produced by reflection of 200 eV protons at tungsten surface.

2. Experimental apparatus

A schematic illustration of the experimental setup is shown in Fig. 1. At the end of the plasma column sustained by 800 G magnetic field, a tungsten target of 50 mm in diameter has been mounted with heating element to control the surface temperature. Dimensions of the discharge chamber are 220 mm in diameter, and 920 mm in length. Plasma can be excited either by tungsten filament cathode, or a microwave applicator.

The area in front of the W target is observed with the light axis set parallel to the target surface. The light along the observation axis is reflected by 90 degree with a copper mirror inside of the discharge chamber, and guided to a vacuum window mounted at the end of the discharge chamber. A condenser lens is mounted in the anodized aluminum cylinder to exclude stray lights, and the lens focuses the image of the sheath in front of the target at the slit of a monochromator of 0.1 angstrom resolution.

The direct light from the hydrogen plasma is bright and the measurement of the Doppler broadening has to be done with poor S/N ratio. To improve the S/N ratio, H_α spectrum will be recorded phase sensitively by modulating the target bias voltage.

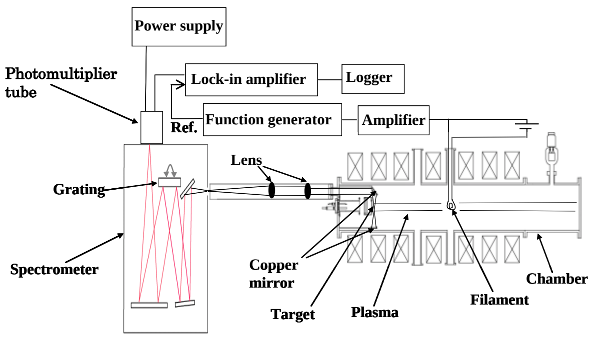

Fig. 2. Illustration of the experimental setup to measure the H_α Doppler shift of H atoms from W surface.