§ 15. Angular Distribution of Hydrogen Ions Reflected from Carbon Coated Refractory Metal Surface

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Precise information on the charge states of the reflected particles at the container wall is indispensable to understand wall-plasma interaction of thermonuclear fusion reactors. Experimental data on the angle resolved energy distribution can be utilized to confirm the validity of theoretical models, which form the basic components formulating a theoretical model to calculate reaction processes in plasma near the wall. One important question in designing a fusion experimental device is the effect of carbon deposition on W or Mo, as these materials will probably be used for next generation experimental devices. Therefore, the charge states of hydrogen was investigated with an apparatus capable of measuring angle resolved energy distributions.1)

Several modifications of the experimental device have been made to improve the signal to noise ratio. The mass separation unit was also added to the beam injection system to separate protons and molecular hydrogen ions from impurity ions. With the present configuration, the energy spectrum of the surface produced negative ions can be measured with enough accuracy. The yields of positive and negative hydrogen ions by hydrogen ion beam injection onto Mo surface were measured by integrating the energy spectrum.

In Fig. 1, positive and negative ion yields by reflection of hydrogen ions and protons at the same velocity are compared as functions of exit angle, β. The angular distribution for molecular ion incidence shows a broader peak than that for proton incidence. The ratio of negative ion yield to positive ion yield does not show an evident angular distribution for bare Mo surface.

Figure 2 shows the ratio of negative ion current to positive ion current from carbon coated Mo surface. In the figure, the abscissa corresponds to the number of shots of the ion beam irradiation, which is in proportion to the ion beam dose. As shown in Fig. 2, carbon coating reduced the negative ion yield, and the yield approached to the value of bare Mo surface as the incident beam dose was increased.2) Further study is being made to confirm this behavior of hydrogen reflections from various kinds of carbon coated refractory metal surface.

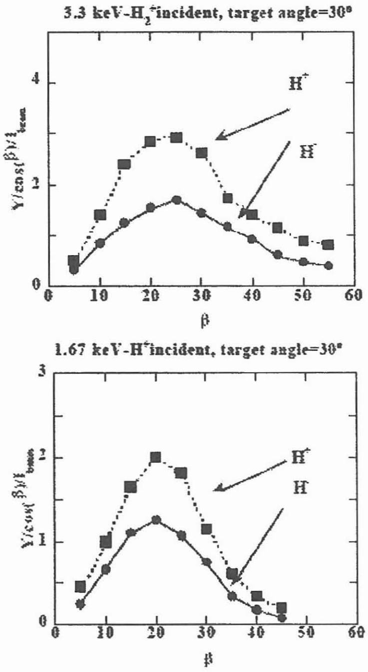

Fig. 1. Graphs showing (a), the angular distribution of the negative ion yield and the positive ion yield due to incident molecular hydrogen ions, and (b), those due to incident proton at the same velocity.

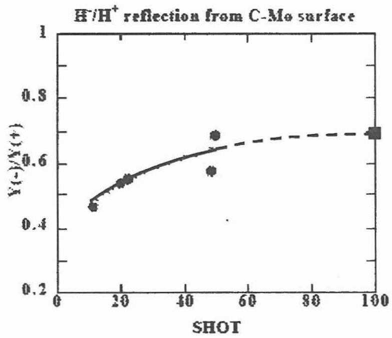

Fig. 2. Evolution of the ratio of negative ions to positive ions reflected from carbon coated Mo surface. As the number of shots proportional to the ion dose increases, the ratio approaches the value of the pure Mo.

References

1) M. Wada *et al.*, Rev. Sci. Instrum., Vol. 73, 955(2002).
2) M. Sasao *et al.*, *Proceedings of 30th EPS on Plasma Physics and Controlled Fusion*, St. Petersberg, July (2003).