§18. Particle Reflections of Low Energy Light Ions from a Polycrystalline W Surface

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We have been developing an experimental system to study interactions of beams with solid surfaces. The system has successfully produced ion spectra reflected from Mo, carbon coated Mo, and W targets.[1-3] Here we report the results of the study on particle reflections from a polycrystalline W surface, bombarded by low energy (1-2 keV) hydrogen and oxygen ions. Figure 1 shows examples of the contour plots of energy and angular resolved intensity profiles for H and O ions reflected from a room temperature W surface at an incident angle of 20^o for a 2 keV H^+ beam and a 0.8 keV O^+ beam injection. The intensity of the reflected positive ions is higher than that of the negative ions in the case of hydrogen. We obtain similar results for H_2^+ and H_3^+ beam injections. The reflected H^- ions show an almost elastic scattering, while the H^+ ions are reflected with energies smaller than the incident beam energies. There is no reflection angle dependence on the reflected beam energies for H^+ beam injection. The width of the angular distribution of the reflected beam is of the order of 10 ^{o} and it widens as the reflection angle increase. The reflected beam has a long tail at the higher reflection angle side. In the case of the O^+ beam injection, the O^- ion production rate is much higher than the O^+ ion production rate and this was common for the other tested materials such as a polycrystalline Mo and Si 100 crystal. The reflected oxygen ions show a strong dependence in angular distribution against the reflected beam energy. This is very different from the results for the H^+ beam injection. These phenomena are also common for the other target materials. Figure 2 shows the angular distributions of the intensities of the reflected H^+ and H^- ions for 2 keV H^+ beam injection and those of O^+ and O^- ions for 0.8 keV O^+ beam injection. The intensity is the integral of the reflected beam energy profile at a given incident (α) and reflection (β) angle. The components of the horizontal and vertical axes mean projections of the intensities to the horizontal and vertical axes. The total intensity is the root of the square of the sum of the horizontal and vertical components. Solid lines correspond mirror reflections. We can observe the mirror reflection in the lower incident angle. But the angle of the reflected ion beam is smaller than the mirror angle as the incident angle increases.

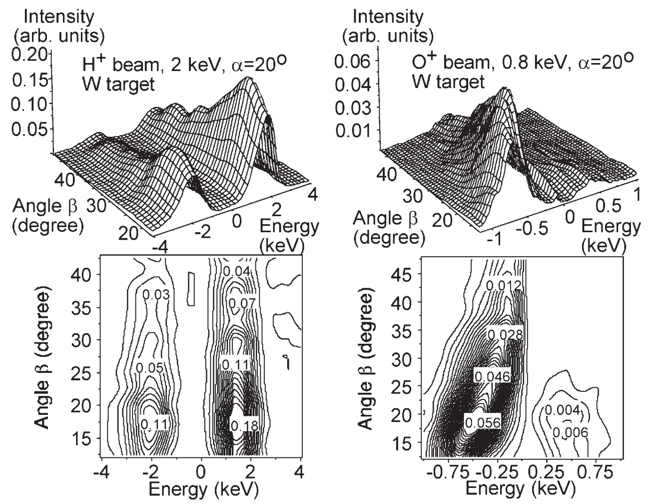

Fig. 1 Contour intensity plots of energy and angular resolved intensity profiles of H and O ions reflected from a W surface at the incident angle of 20^o for H^+ beam injection.

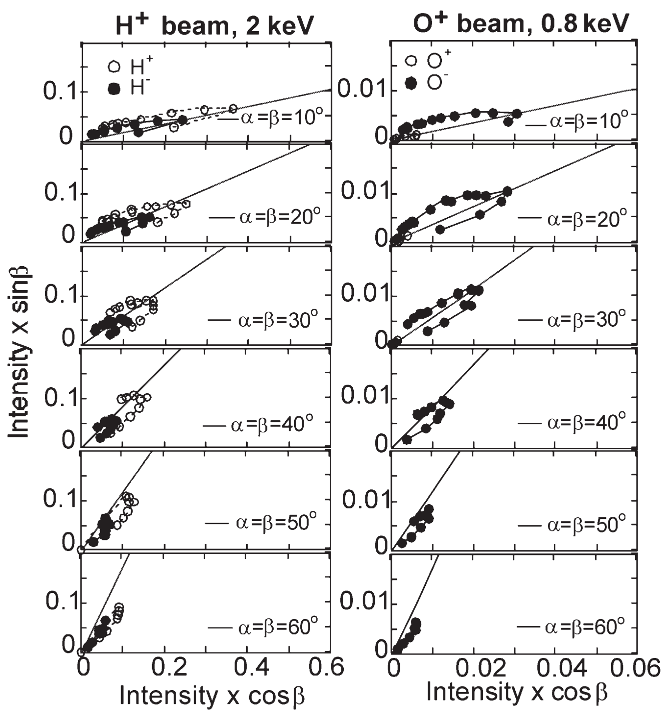

Fig. 2 Angular distributions of reflected H^+ and H^- ion intensi1ies for 2 keV H^+ beam injection and those for O^+ and O^- ions for 0.8 keV O^- beam injection.

References

1) M. Wada, *et al*., Rev. Sci. Instrum. **73** (2002) 955.
2) H. Yamaoka, *et al*., J. Nucl. Mater. **337-339** (2005) 942.
3) H. Yamaoka, *et al*., Rev. Sci. Instrum. **77** (2006) 03C301.