§ 9. Recycling of Fuel Particles and Production and Transport of Impurities at the First Wall

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For details understanding of the particle balance as well as the energy balance in the recycling of fuel and ash is of essential importance to measure directly the energy distribution of the neutral particles emitted through the boundary plasma via the charge exchange processes in dependence on time. One of the most promising techniques for measuring the neutral particles is the time of fight (TOF) analysis. In the previous project, we have determined the absolute value of the quantum efficiency of the detector (micro channel plate) for neutral particles (H, D, and He) in dependence on their kinetic energy which is used in the TOF-neutral particle detection system.

The aim of this project is to discriminate He, T and D among the neutral particles emitted the D-T burning Plasma. One of most promising method for the particle Discrimination is the ionization of neutral particles and The post mass analysis in the TOF measurement: One of the ionization is laser photo-ionization and the other is the surface scattering under specular reflection condition. The latter technique is the most appropriate for He, because of its high ionization potential.

In this report, we compare the experimental data on the ion fractions of backscattering intensity of He^+ ions from the different targets: monolayer metal adsorbates on Si surfaces and insulating targets, as a function of the scattering energy which have been measured using the CAICISS system.

For targets of monolayer metal adsorbates on Si surfaces, Ag and Au films show rather high values of the He^+ fraction which have no oscillatory variation but decrease gradually with their scattering energy However, the other films of Sb, Sn, Pb, and Bi show oscillatory variation with their scattering energy. Typical results on Ag and Sn are shown in Figs. 1 and 2.

For insulating target of NaCl crystal, the charge up effect has been observed to reduce completely the He^+ fraction at no bias voltage and to recover it at a bias voltage higher than the charging-up potential. The result is shown as a function of their scattering energy in Fig.3,where the data for target heated are also shown for comparison. For LiF crystal, almost the same value has been observed even at no bias voltage, because of its wide band gap energy.

From comparison among the data in Figs. 1, 2 and 3, it is seen that Ag and Au films are appropriate for target to ionize He neutrals, which originates in the high probability of reionization via electron promotion in the quasi-molecule formed during the close collision of He-Ag.

For practical use, testing with bulk targets is required, because of too short lifetime of monolayer metal adsorbates.

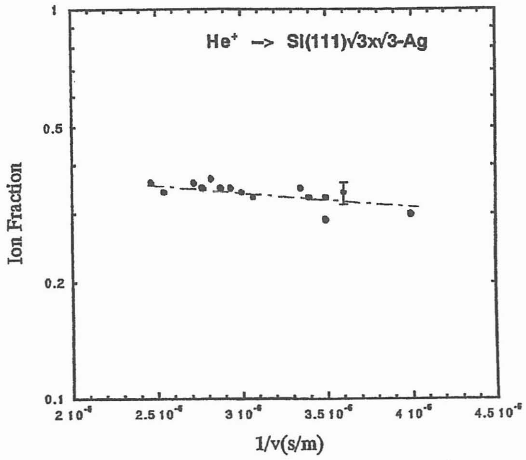

Fig.1 Ion fraction in 180 backscattering of keV He^+ ions from monolayer Ag adsorbate on Si surface as a function of 1/velocity.

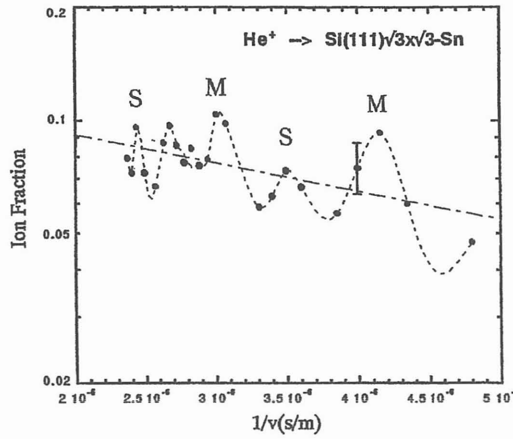

Fig.2 Ion fraction in 180 backscattering of keV He^+ ions from monolayer Sn adsorbate on Si surface as a function of 1/velocity.

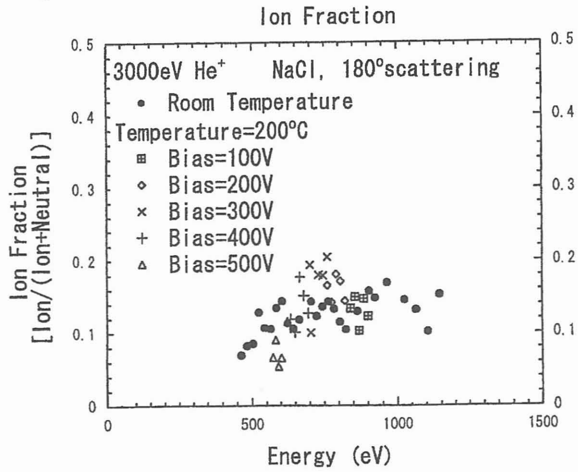

Fig.3 Ion fraction(•) in 180 backscattering of 3 keV He^+ ions from NaCl at room temperature,where for comparison are shown those of 1.5 keV He^+ ions from NaCl heated at 200°C obtained by biasing at different voltages.