

New mechanism of ion desorption from rare gas solids by multiply-charged ion impact

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Synopsis We have measured the absolute ion desorption yield from the surface of solid Ne and Ar by low-energy multiply-charged ion impact. Present results could not be explained by well-known Coulomb explosion model. We here propose a new mechanism of ion sputtering.

Potential sputtering is the desorption mechanism which is induced by transfer of the potential energy from incident ions to the solid surface. We have reported previously the relative ion yields of potential sputtering from solid Ne [1], and demonstrated that the sputtering ion yields are proportional to the potential energy of the incident ion. Here, we report the experimental results of the *absolute* sputtering yields, and propose a new mechanism of ion sputtering.

Figure 1 shows the absolute sputtering ion yields as a function of the potential energy of the incident ion. Incident ions are Ne^{q+} , Ar^{q+} , and Kr^{q+} , and the target is solid Ne (circles) and solid Ar (triangles). The thickness of the marks denotes the kinetic energy of the incident ions (200 ~ 2000 eV), the thicker color, the higher energy. It is clearly shown that the sputtering ion yields linearly increase with the potential energy of the incident ion, which is consistent with our previous work [1]. It is found that our results cannot be explained by the Coulomb explosion model, where the ion sputtering yields should be proportional to the number of ion pairs created in the solid.

In order to explain our results, we propose a new desorption mechanism, where ions are created in the solid by the charge transfer with the incident multiply-charged ions, and part of them desorb with surrounding neutral atoms. In this model the ion sputtering yield Y_{ion} should depend on a scaling parameter $\Gamma \equiv (\text{PE}/\text{IP}) \cdot \sigma \cdot Y_{\text{total}}$, where PE and IP are the potential energy of the incident ions, and the ionization energy of the solid atom, and σ and Y_{total} are the charge transfer cross section [2] and total desorption yields [3], respectively.

Figure 2 shows the scaling plot based on our new model. As can be seen in the figure, our model well describes the experimental results regardless of the incident ion species, incident energy, charge state, or target material. Detailed

discussion will be given at the conference.

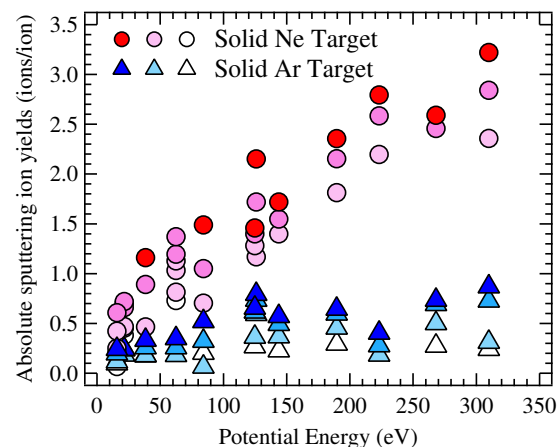


Figure 1. Absolute sputtering ion yields as a function of the potential energy of the incident ion. Incident ions are Ne^{q+} , Ar^{q+} and Kr^{q+} , and the target is solid Ne (circles) and solid Ar (triangles).

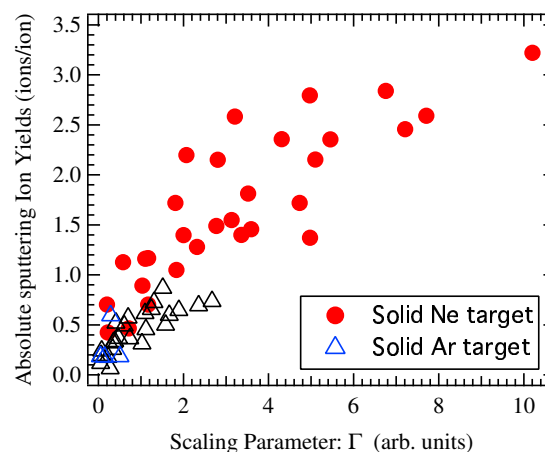


Figure 2. Scaling plot based on our new model.

References

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