Secondary Electron Emission from Carbon Foils under O^{2+} Ion Impact

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Synopsis Secondary electron emission yields in forward and backward direction from carbon foils (thickness of 74 nm) induced by O^{2+} ions of energies form 1.9 keV/u to 11.3 keV/u have been measured. We find that the forward and the backward electron emission yields increase with the projectile kinetic energy. Further studies showed that the forward and the backward electron emission yields are approximately proportional to the electronic stopping power at the exit and entrance surfaces, respectively.

The secondary electron emission (SEE) from solid target surface induced by heavy ions is very important in fundamental research and in many related techniques and applications, thus the investigation of SEE has attracted considerable attention during the past decades [1-3]. The experimental study about the SEE was done at the 320kV highly charged ions physics ECR platform in Lanzhou.

In this experiment, we have studied the forward and backward electron emission yields as a function of electronic stopping power by changing the projectile ion energy. Preliminary results indicated that with the increase of projectile kinetic energy, the SEE yields from both surfaces of foils increase correspondingly. In order to obtain the dependency relationship between the SEE yields and electronic stopping power, we use SRIM-2012 [4] to calculate the electron stopping power at different energies. Figure 1 shows the forward and backward SEE yields (γ_F and γ_B respectively) induced by O^{2+} impacting on carbon foil with thickness of 74nm as a function of electronic stopping power.

We fitted the experimental data by linear relation. The fitting formulas are as follows:

$$\gamma_B = 0.2 + 11.4 S_e \quad (1)$$

$$\gamma_F = -0.7 + 13.4 S_e \quad (2)$$

Due to the projectile momentum distribution which is mainly along the incident direction, the coefficient of S_e in formula (2) is somewhat larger than that in formula (1). We also find that the intercept in formula (2) is negative but positive in formula (1). The negative intercept (-0.7) reveals that there is a threshold energy for SEE. However, since the potential energy of ions would mostly be deposited at the incident surface of the foil and, in turn, induce backward SEE, the intercept in formula (1) corresponding to the backward SEE is positive.

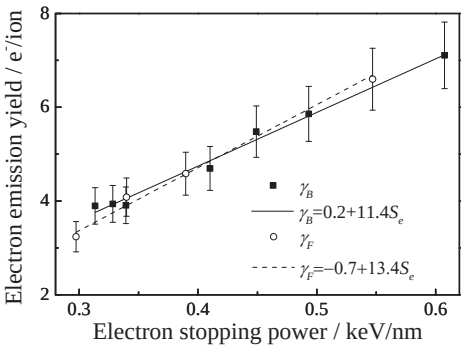

Figure 1. Electron stopping power at the entrance and exit surfaces dependence of the SEE yield from the forward and backward directions, respectively.

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