

Potential sputtering on SiO₂ and Au induced by highly charged ions impact

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Synopsis: Potential sputtering was studied using highly charged ions impacting on SiO₂ and Au surface. A threshold effect for potential sputtering was found for gold.

A large amount of potential energy is carried by the highly charged ions. A very high energy power density is produced within the potential energy deposition process, due to the ultrafast release time (~100fs) and the small deposition volume (~100nm³) [1]. As a result, the sputtering yield is enhanced and some nano-defects are produced on the surface [2-5]. However the phenomena induced by the potential energy commonly happen on insulator and semiconductor, few on the metal, due to the fast electrons mobility in conductor [6-7].

More details about the experiment could be found in reference [8] here we present the sputtering results using highly charged Pb ions impacting on SiO₂ and Au surfaces. Figure 1 shows that the sputtering yields increase with the potential energy when the 400 keV Pb^{q+} ions impact on SiO₂ and Au surfaces. For the insulator, the sputtering yield increases linearly with potential energy. But the sputtering on the gold metal is quite different from the insulator case, and the sputtering yield remains constant when the charge state is lower than 24. The sputtering yield increases as a function of $E^{1.2}$, when the charge state is higher than 24. Considering the energy level matching, the electrons are resonantly captured into the inner shell of the projectile ions instead of cascade deexcitation from the outermost shell. As a result, the high energy power density is produced in the higher charge states case.

It is obvious that on the insulator surface, the potential energy is dissipated into a small volume, since the electrons are trapped, which creates a high energy power density to produce the sputtering. In the metal, the potential energy is easily dissipated into a larger volume due to the amount of free electrons. The rate of energy deposition becomes higher than the rate of diffusion, only when potential sputtering is observed.

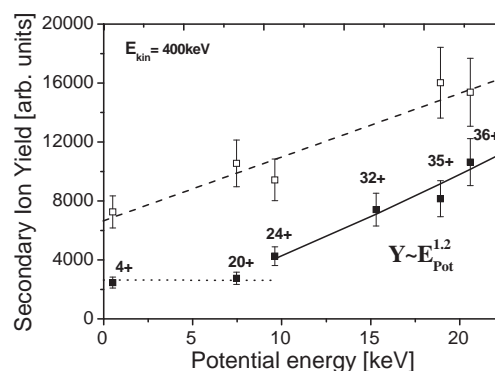


Figure 1. Sputtering yields increase as a function of the potential energy when Pb^{q+} impact on SiO₂ and Au surfaces.

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