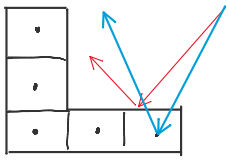
Reflection

Wednesday, September 2, 2020 3:21 PM

REFLECTION

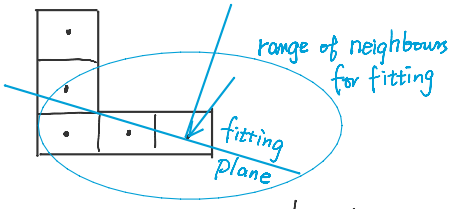
All Reflections occur on Nodes instead of SURF



Find the reflecting surf

Cell surf is only horizontal or vertical

On nodes, surf is determined by plane fittin

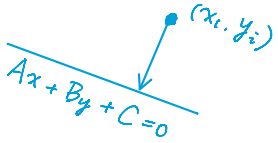


assume the fitting plane is

$$Ax + By + C = 0$$

for neighbours (x_i, y_i)

the distance from (x_i, y_i) to plance



$$dist = \frac{|Ax_i + By_i + C|}{\sqrt{A^2 + B^2}}$$

Minimize total dist

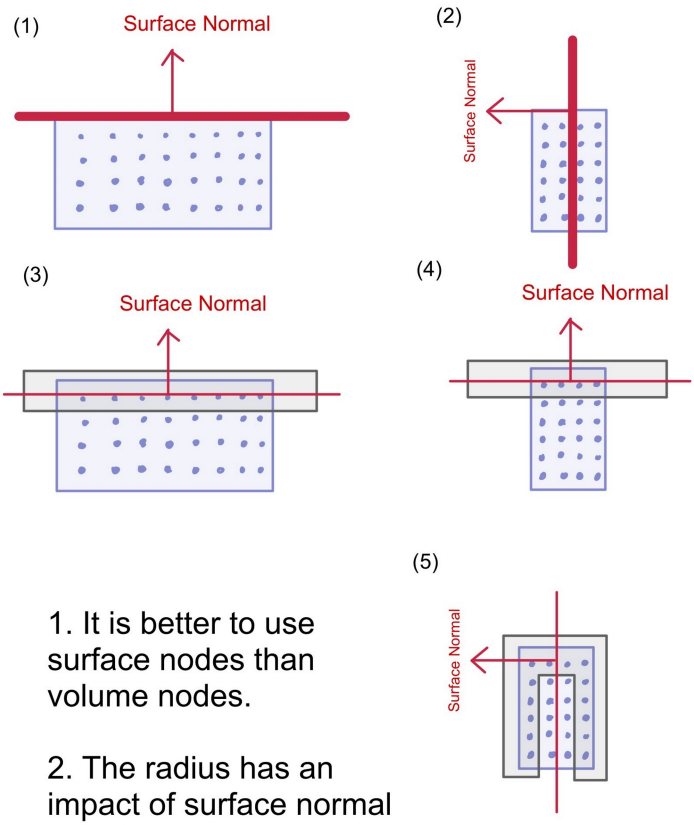
$$D = \sum_i dist(x_i, y_i)$$

Usually, a simpler form is used

$$Q = \sum_i (Ax_i + By_i + C)^2$$

This sum can be only fitted on nodes

Once the fitting plane is determined



1. It is better to use surface nodes than volume nodes.

2. The radius has an impact of surface normal calculation.

This surf can be only fitted on nodes
Once the fitting plane is determined
surf norm $\hat{n}$ is chosen from
Mat to Vac

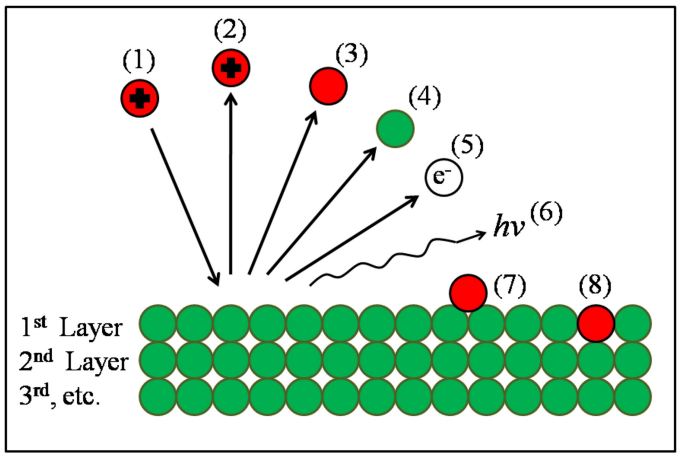
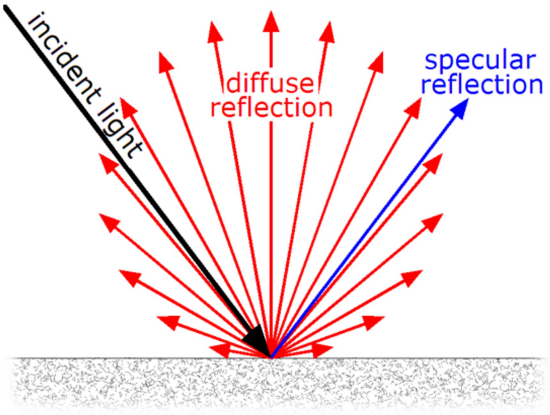
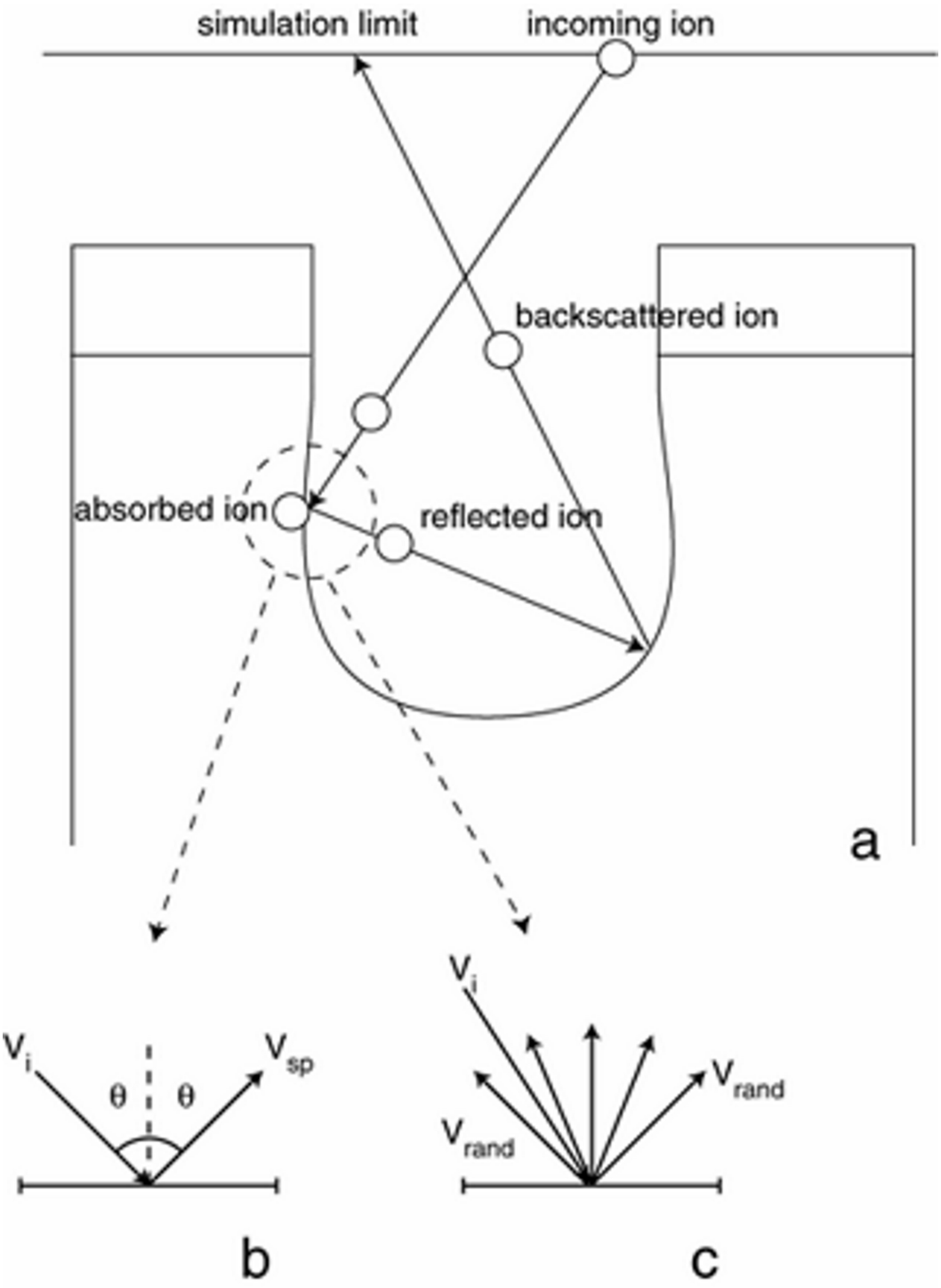


Diagram of various ion-surface interactions (non-exhaustive). (1) Incoming ion; (2) Scattering; (3) Neutralization and scattering; (4) Sputtering or recoiling; (5) Electron emission; (6) Photon emission; (7) Adsorption; (8) Displacement.

DIFFUSE REFLECTION

- Neutral particles with thermal, or near thermal (< 1 eV) energies reflect or re-emit from surfaces diffusively following a cosine angular distribution.
- This occurs because each particle is in thermal equilibrium with the surface, allowing them to briefly physisorb to the surface, before being re-emitted into the gas by vibrational processes in the solid, such as phonon scattering.
- The emitting probability density function depends on the particel and surface condition.




simulation limit
incoming ion
backscattered ion
absorbed ion
reflected ion
a
V_i
V_{sp}
θ
θ
b
V_i
V_{rand}
V_{rand}
c

ENERGY LOSS DURING THE REFLECTION

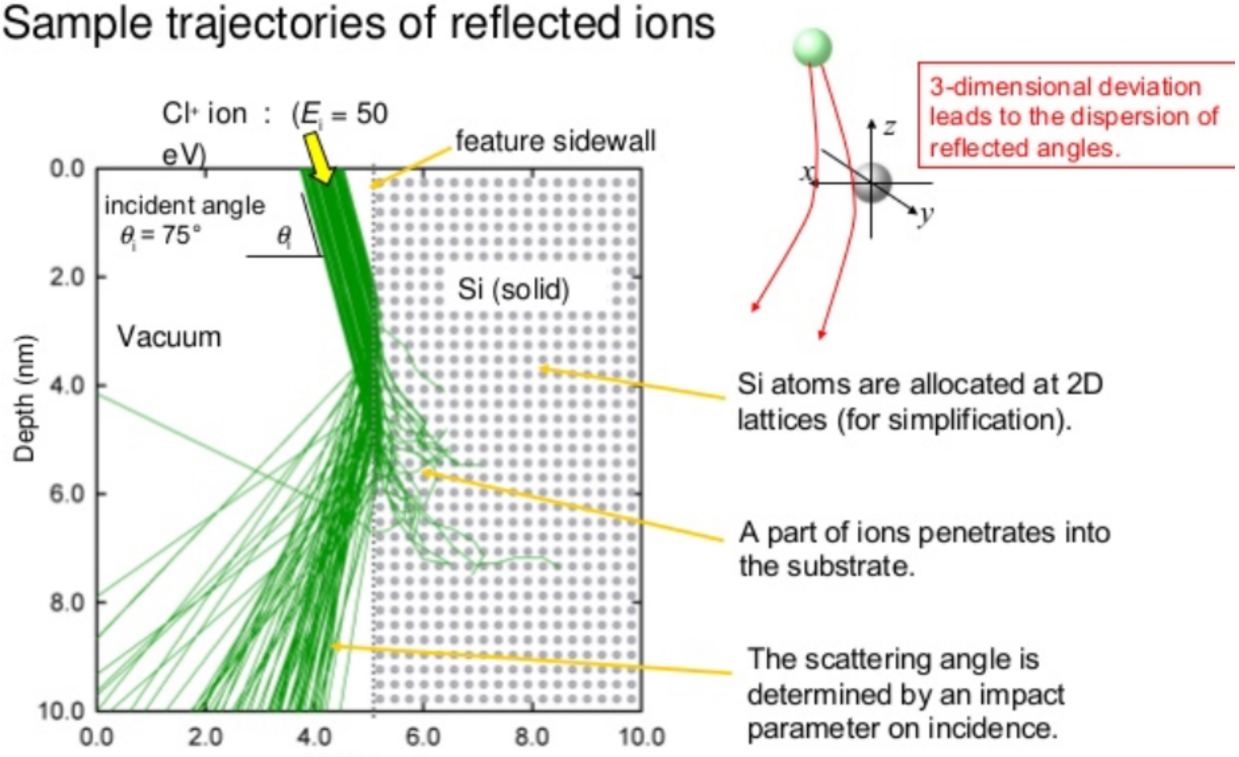
- Particles lose energy during the reflection as a function of initial energy and incident angle.

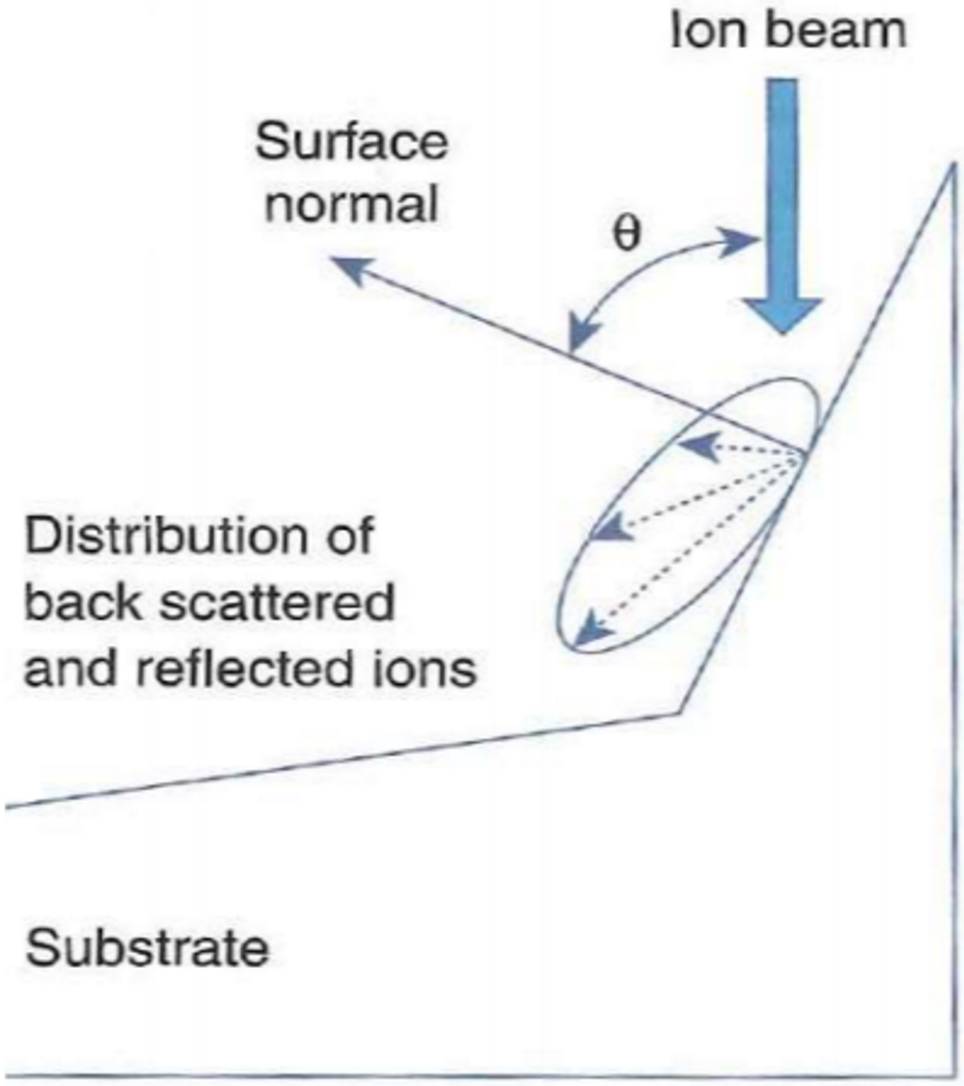
$$\varepsilon_f = \gamma_0 f(\theta) f(\varepsilon_i) \varepsilon_i$$

$$f(\varepsilon) = \begin{cases} 0 & \text{if} \quad \varepsilon < \varepsilon_0 \\ \dfrac{\varepsilon - \varepsilon_0}{\varepsilon_s - \varepsilon_0} & \text{if} \quad \varepsilon_0 \le \varepsilon \le \varepsilon_s \\ 1 & \text{if} \quad \varepsilon > \varepsilon_s \end{cases} \qquad f(\theta) = \begin{cases} 0 & \text{if} \quad \theta < \theta_0 \\ \dfrac{\theta - \theta_0}{\theta_0} & \text{if} \quad \theta > \theta_0 \end{cases}$$

for example, $\gamma_0 = 0.85$, $\varepsilon_0 = 0$ eV, $\varepsilon_s = 50$ eV and $\theta_0 = 30°$

Sample trajectories of reflected ions





Ion beam gets deflected by tilted faces *