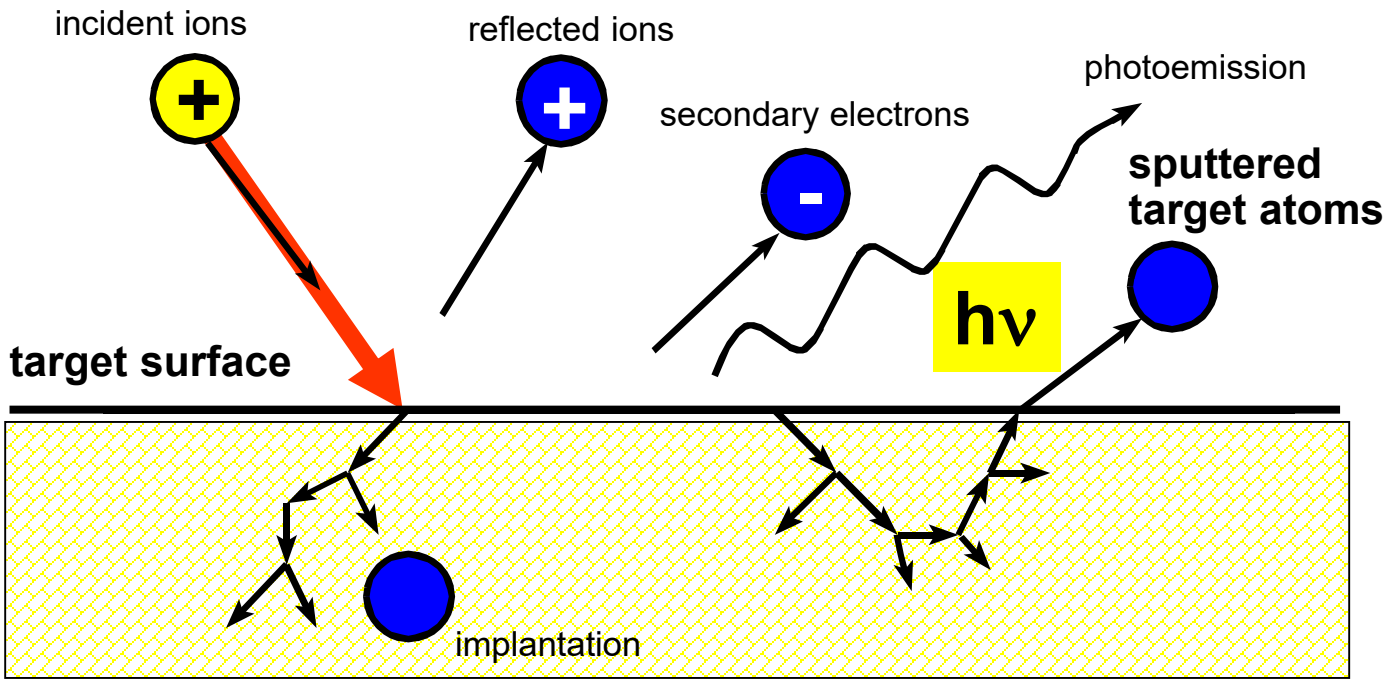
Q11 What are the basic steps/mechanism of sputtering? (elementary processes)

1) Collision cascade in the target by target atom release (later on: transport of the atom towards the substrate / condensation → film formation
2) Reflection of argon ions
3) Argon ion implantation
4) …
5) …
6) …

Elementary processes of sputtering



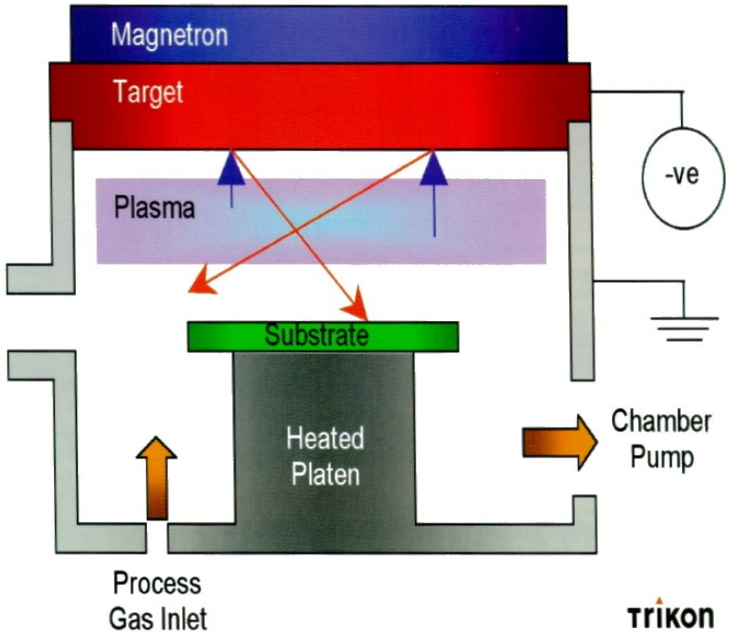
Interaction of ions with the surface

reflection secondary electrons change of stoichiometry
lattice defects radiation damages ion implantation

Sputtering: ***Generation of a collision cascade***

It differs, if the last collision hits an atom in the bulk or at the surface of the target.
Only in the latter case an emission takes place - efficiency 5% to 25 %!

Q12 Please draw a cross-section of a DC magnetron sputtering chamber and name the different parts!



Inspection flange

DC Power source

Target: conducting
(non-conducting → RF sputtering)

Throttle valve for pressure control

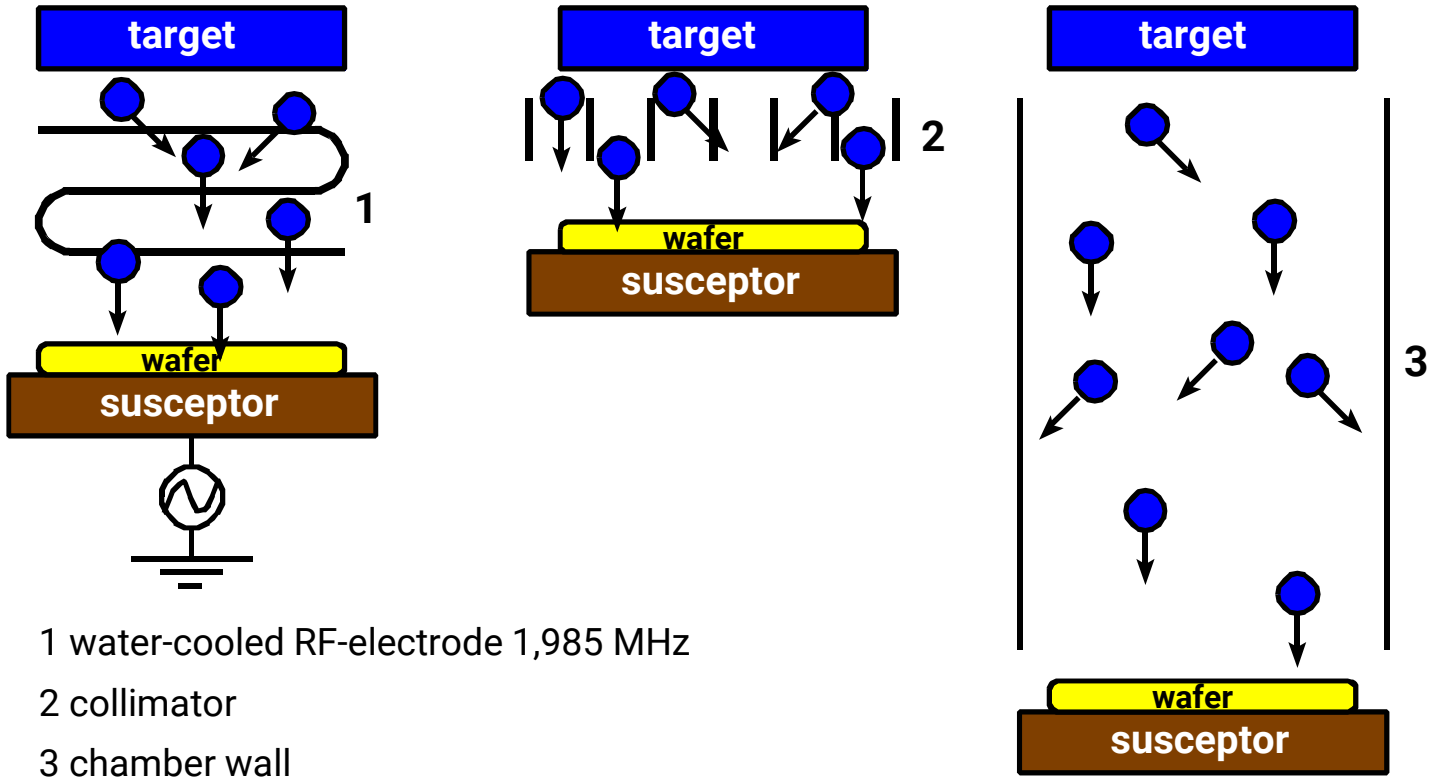
Q13 Which advanced sputtering techniques are possible to improve sidewall coverage in via/trench features?

1) Collimated sputtering

2) long throw sputtering

3) ionized metal deposition

Thin Film Deposition: Sputtering – advanced techniques



1 water-cooled RF-electrode 1,985 MHz

2 collimator

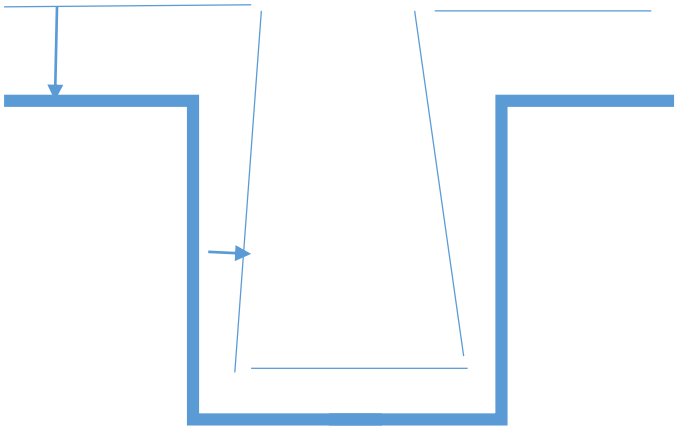
3 chamber wall

ionized metal deposition ***collimated sputtering*** ***long throw sputtering***

Modern principles to coat contact and via holes with a high aspect ratio
(e.g. TiN, TaN or WN barriers for the copper metallization)

Only target particles with a small angle to the substrate normal reach the surface !

Step Coverage:



Step coverage = film thickness in the feature / film thickness on top

If step coverage is 100%, we have a conformal film (deposition)