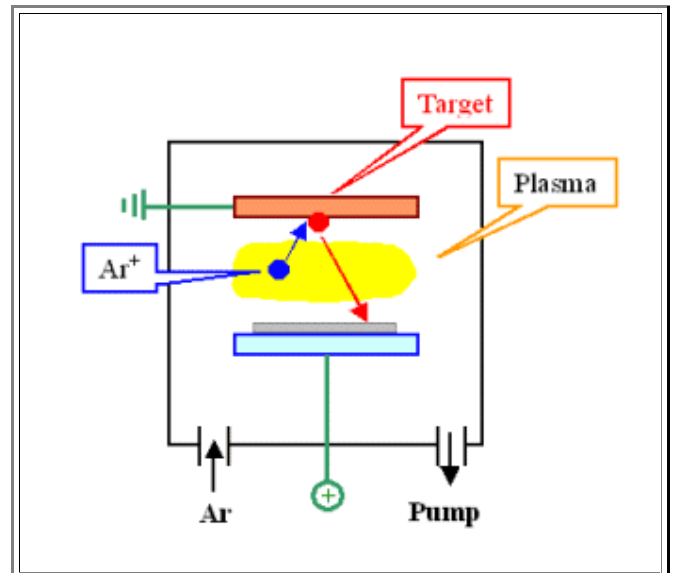


### 6.3.4 Summary to: 6.4 Physical Processes for Layer Deposition

#### Sputter Deposition

- Simple in principle: Shoot off any mixture of atom contained in a target by an ion beam produced by applying high (RF) voltage between target and Si wafer; see picture.
- Great advantage is easy deposition of mixtures of elements, e.g. Al plus traces of Cu etc.
- Disadvantage:
  1. target should be conducting; no (easy) deposition of insulators like  $\text{SiO}_2$ .Target atoms are emitted in all directions, leading to:

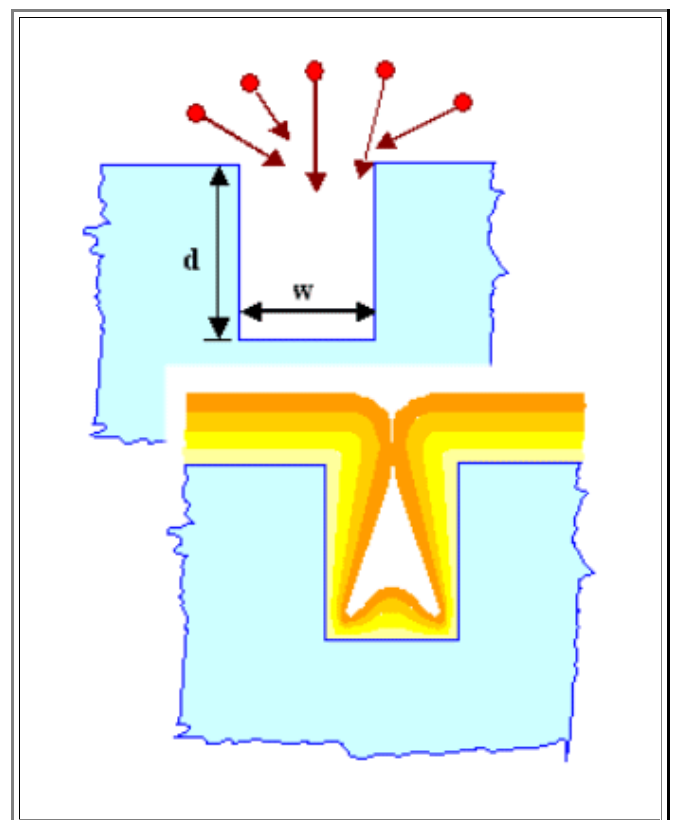


#### "Contact hole filling problem"

- The picture tells it all. At some point you need to go back to CVD processes.

#### Ion implantation. Might be considered to be a "deposition" technique but actually shoots ions into the Si target.

- The technique of choice for doping selected areas with typically B, As or P.. Depth distribution and concentrations finely adjustable in a wide range.
- Major problems:
  1. The Si crystals gets more or less destroyed; in the extreme it turns amorphous. Implantation thus always need a follow-up annealing process that changes dopant distribution by diffusion and may not be able to restore perfectness of the lattice
  2. Implanters are huge, complex and very expensive machines.



#### Other physical deposition techniques.

There are plenty, often quite specialized. Of special important for chip making are.

- Evaporations. Easy but very limited. Rarely used in chip production
- Spin-on techniques (for deposition the light sensitive "resist" needed for lithography)
- Molecular Beam Epitaxy (MBE);: hugely important for III-V technology.
- Galvanic techniques. Hated but used
- Many other.

## Questionnaire

Multiple Choice questions to all of 6.4