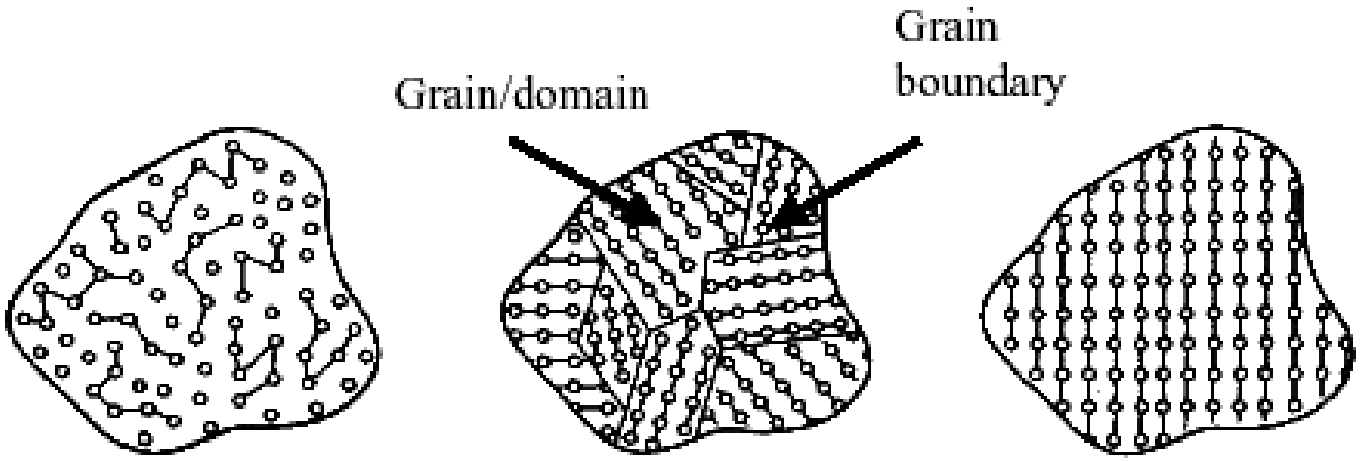
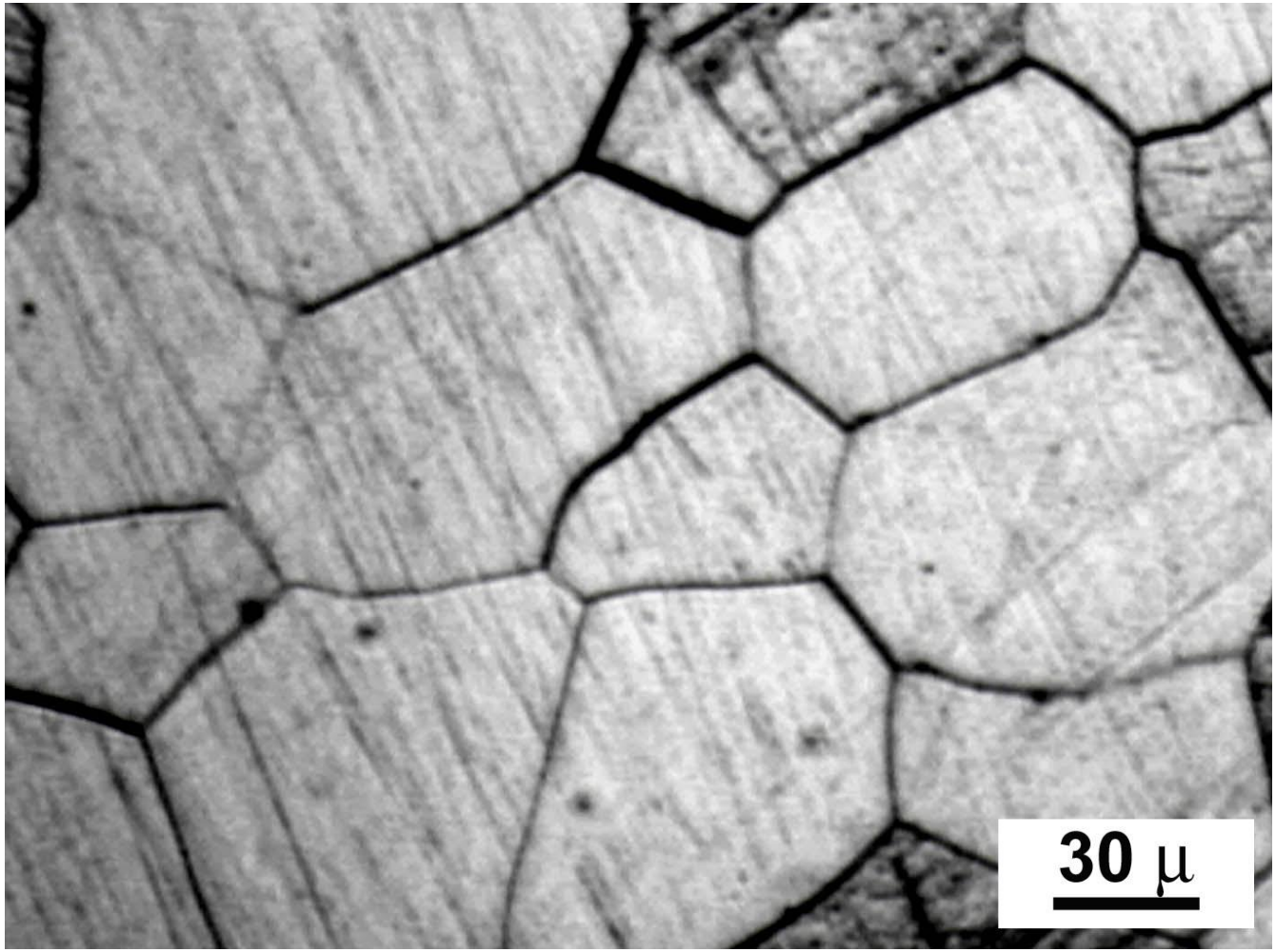
# crystalline structures

**materials:**
**amorphous – polycrystalline – monocrystalline**



**TEM, Al film**

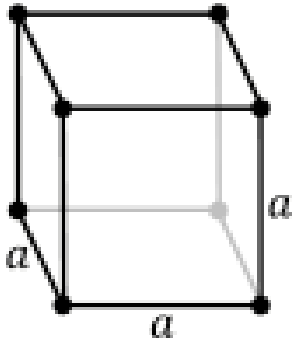



**steel**

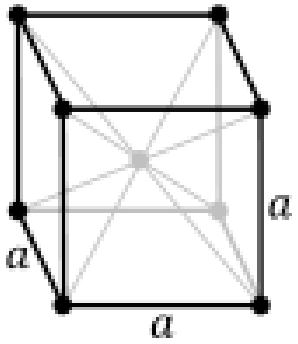
acid etched surface

natural
diamonds

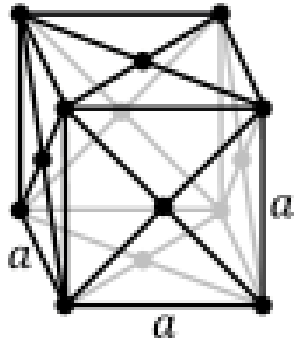
## crystal lattices:



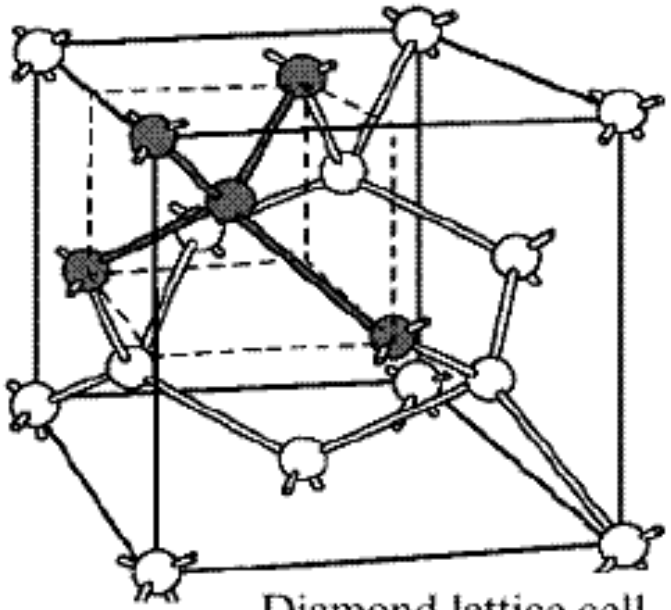

**Simple Cubic lattice**
**Po**
**52 %** filling



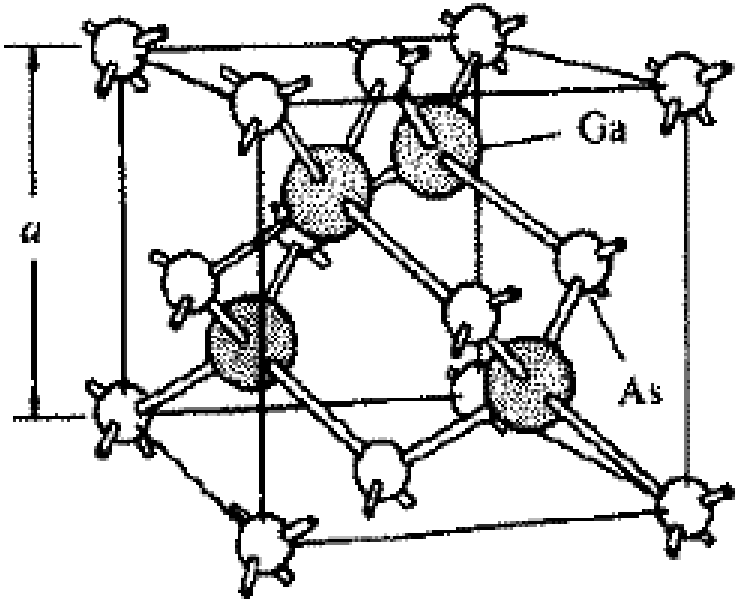

**Body Centered Cubic lattice, BCC**
**α-Fe, Li, Na, K, Na, Mo, Cr, W**
**68 %** filling




**Face Centered Cubic lattice, FCC**
**Cu, Ag, Au, Al, Ca, Ni, Pb, Pt, Pd, α-Fe**
**74 %** filling



Diamond lattice cell

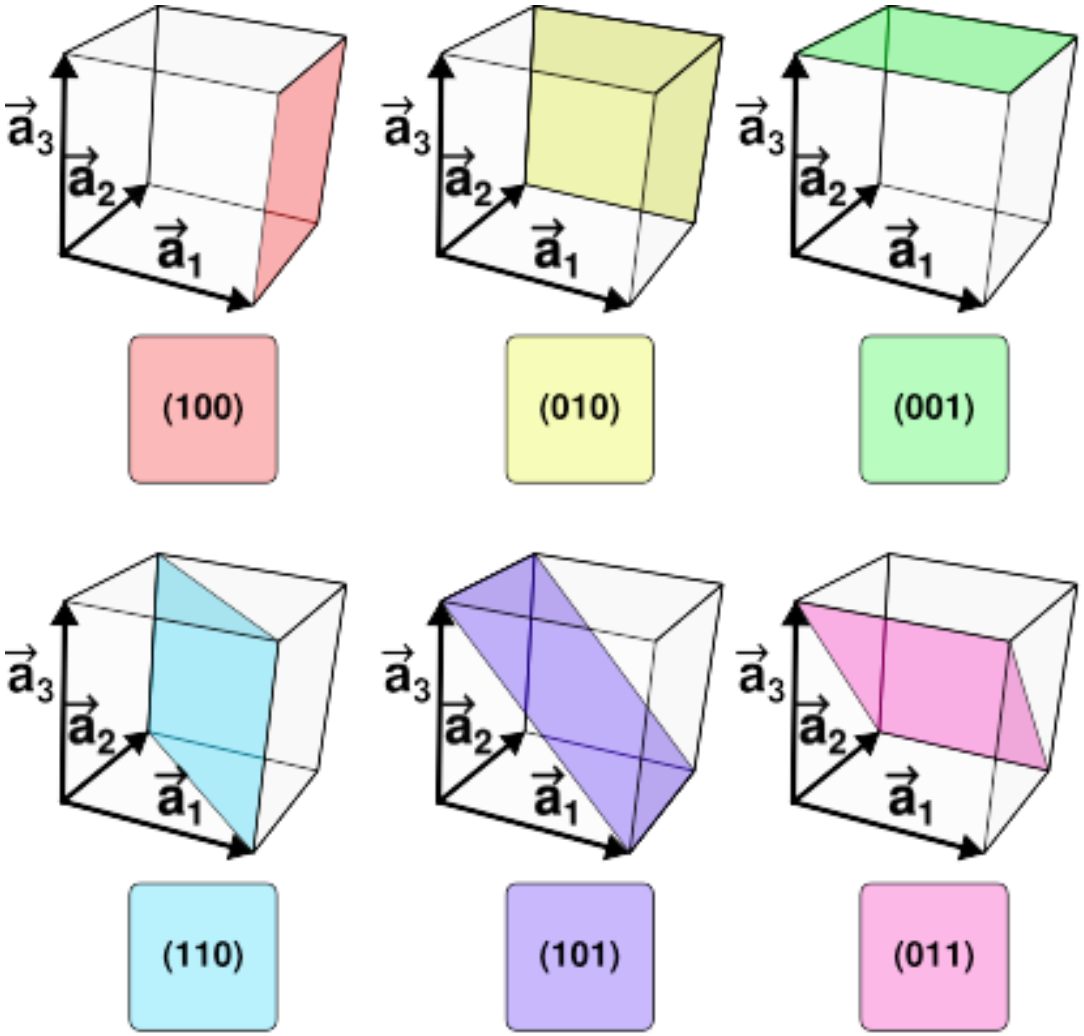



Zincblende lattice cell

**diamond lattice**
(**C, Si, Ge,** Sn)

**34 %** filling

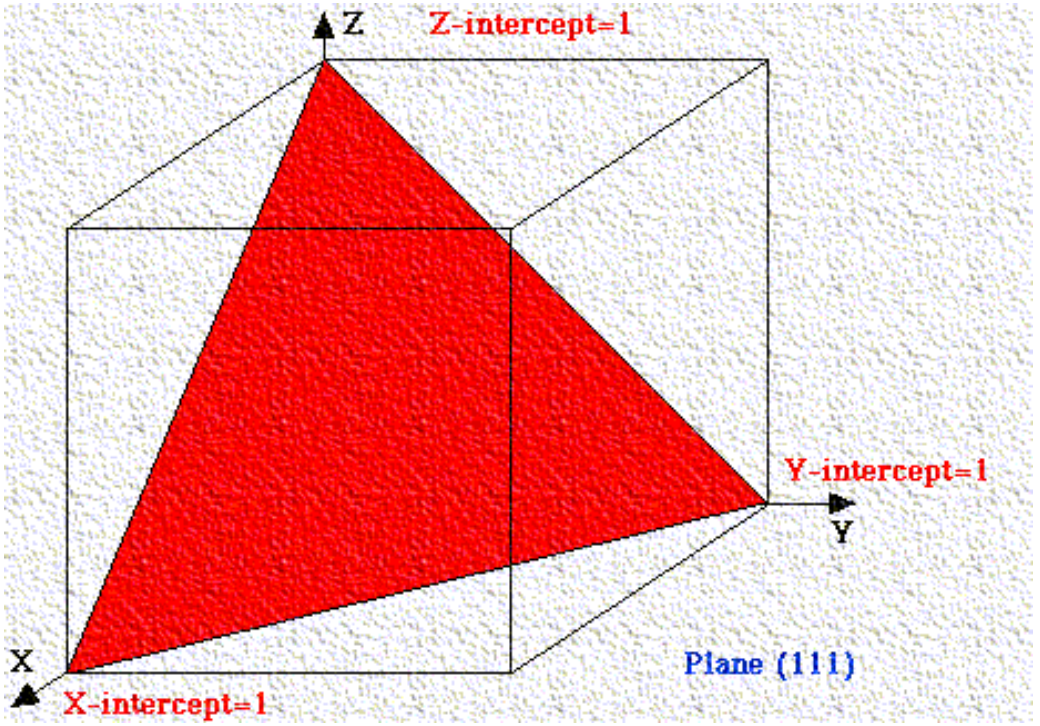
**zincblende lattice**
**(ZnS, GaAs,CdTe,** InP, ZnSe**)**



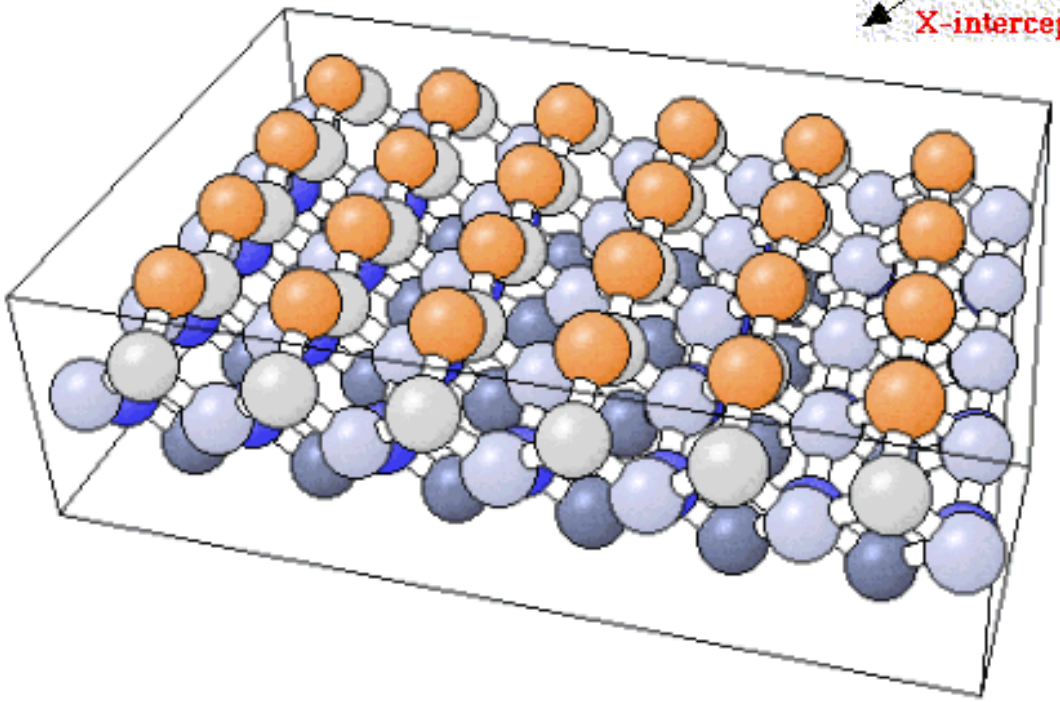

**Miller indices (hkl)**
describe crystal planes

identical properties
in cubic lattice:
**100 = 010 = 001**

electronic properties
depend on crystal plane




**Si (111) plane**



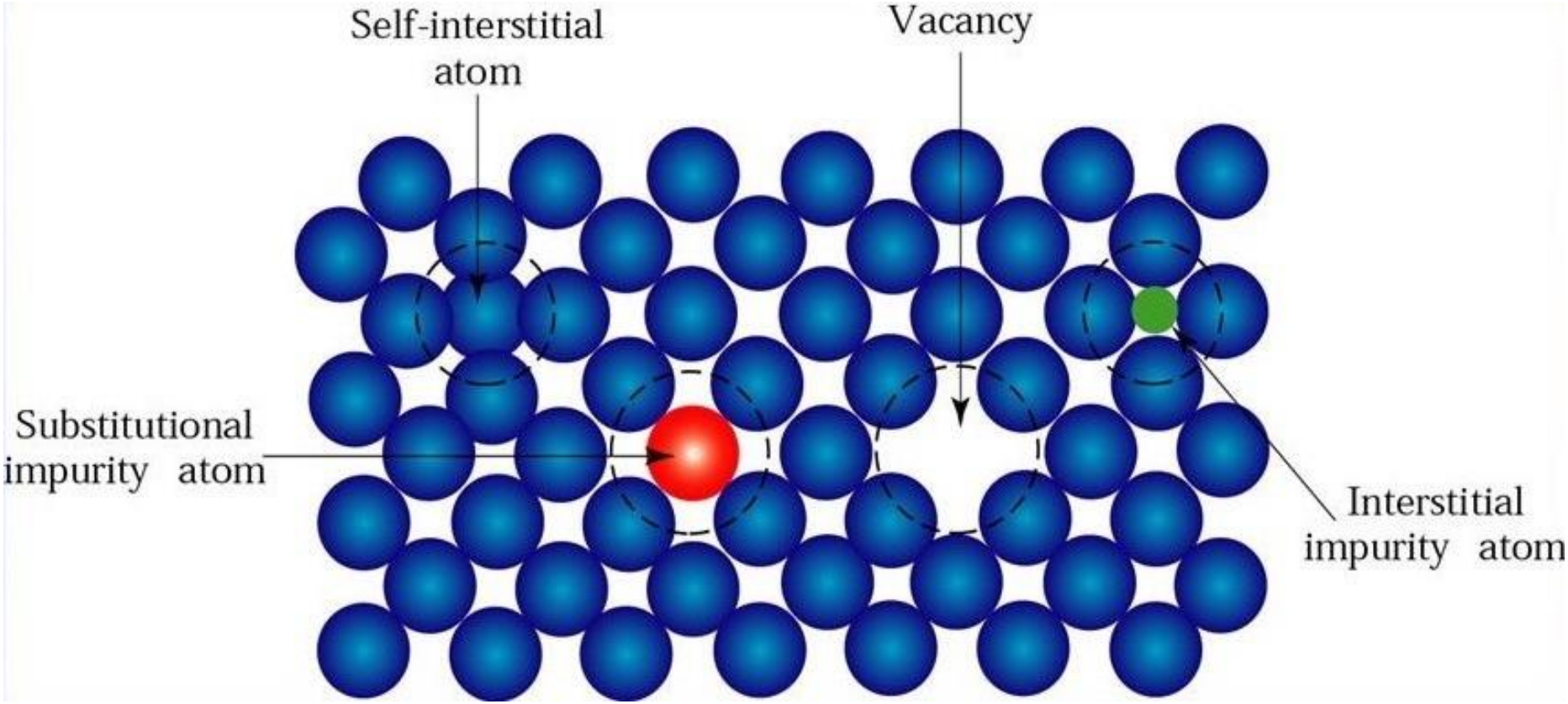
**(100) has lesser atom density**

- lesser current density
- lesser transistor capacity
- lesser crystal growth rate
- lesser oxidation rate

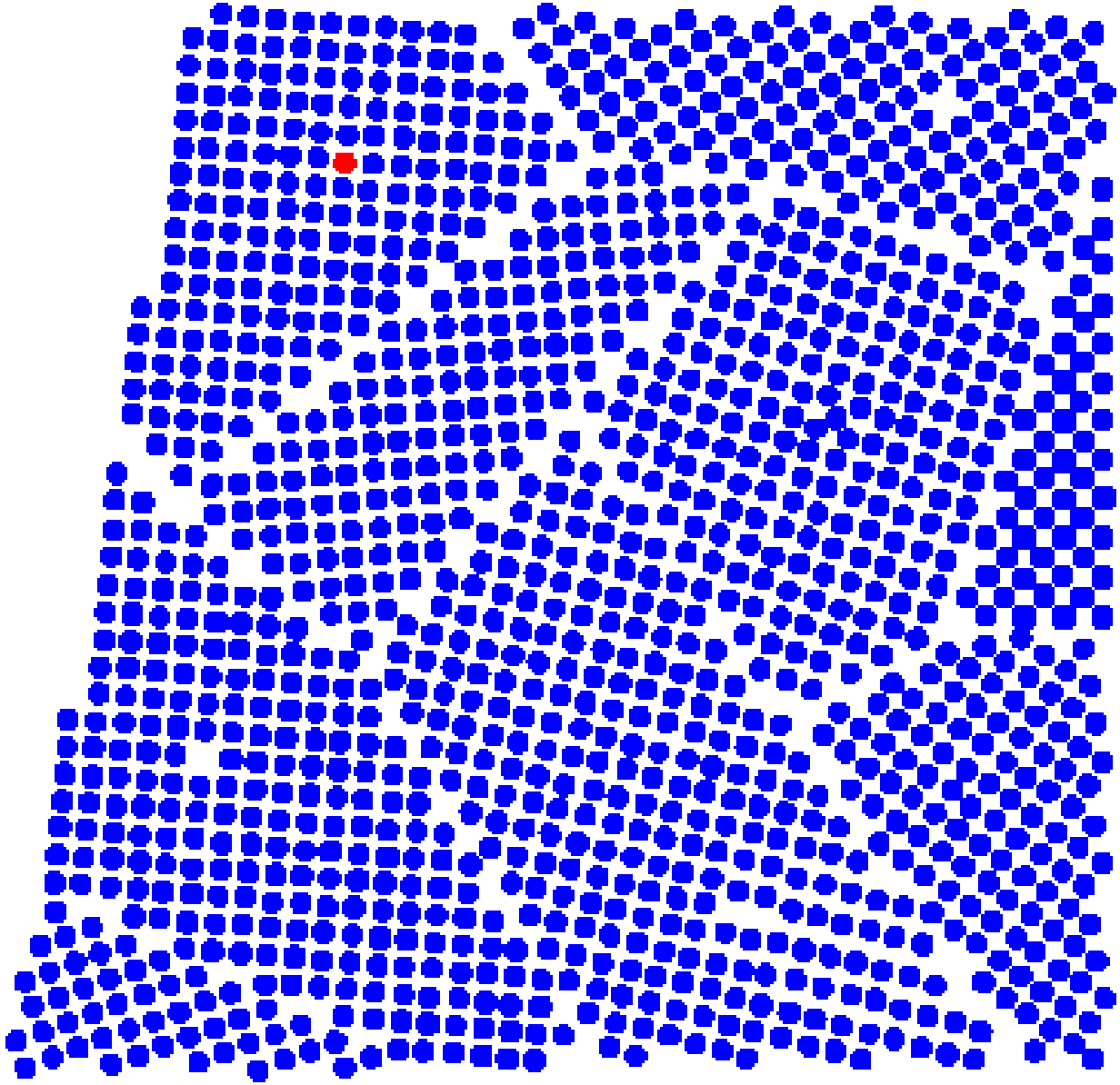
**(100) is used for MOS FET**

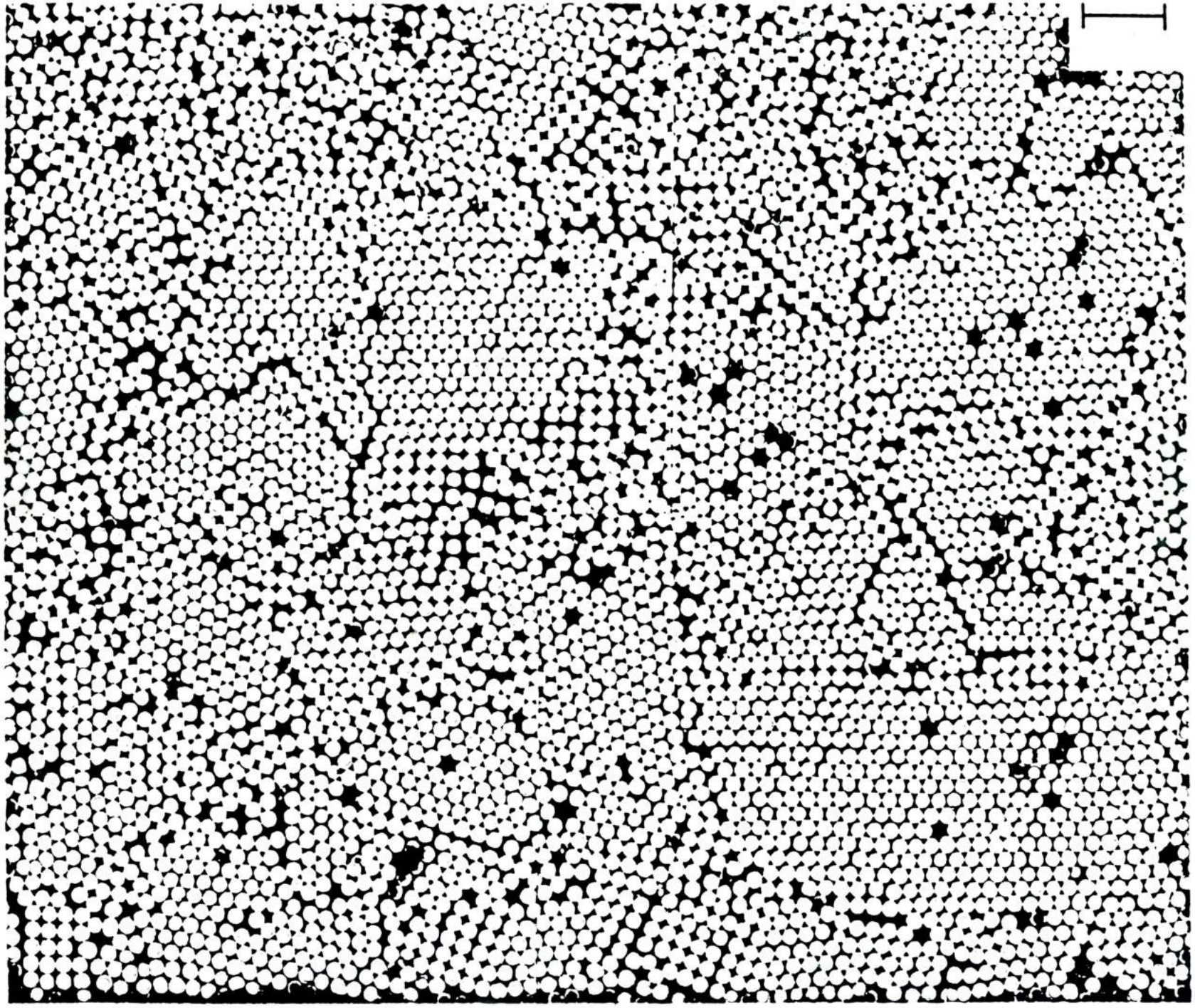
**(111) hi power bipolar trasistors**

**point defects**

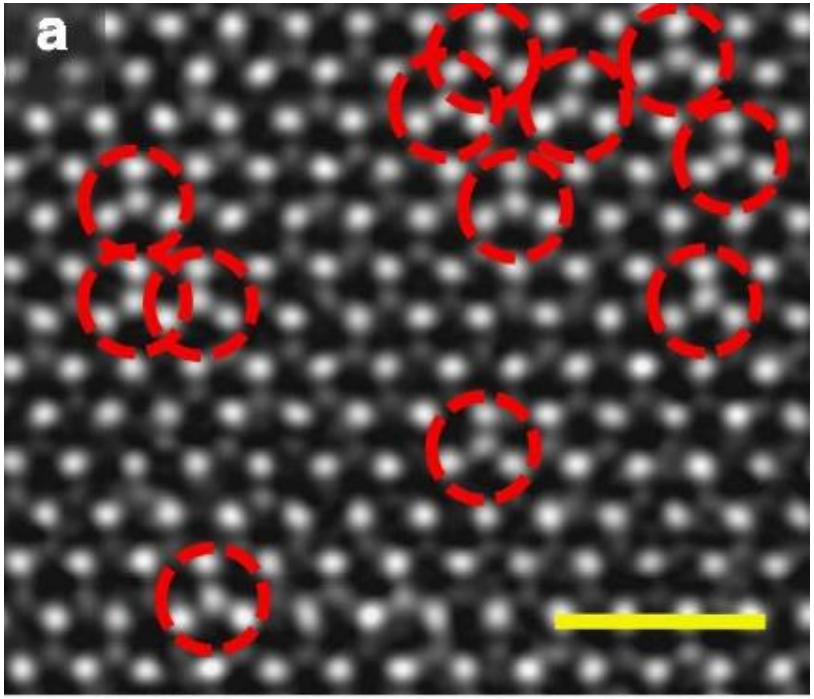


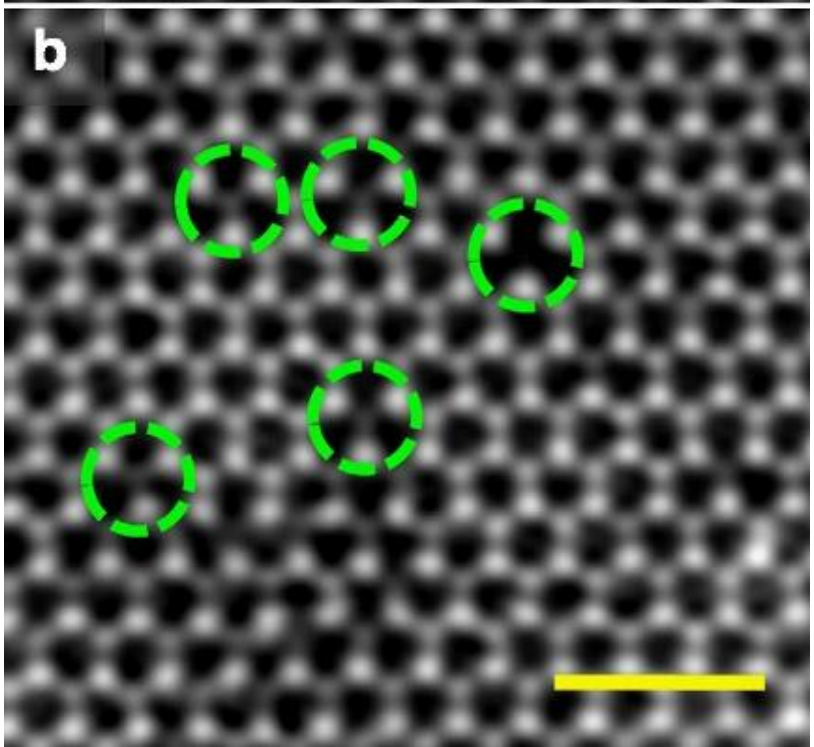
**defects +**
**crystallites**





SEM




TEM

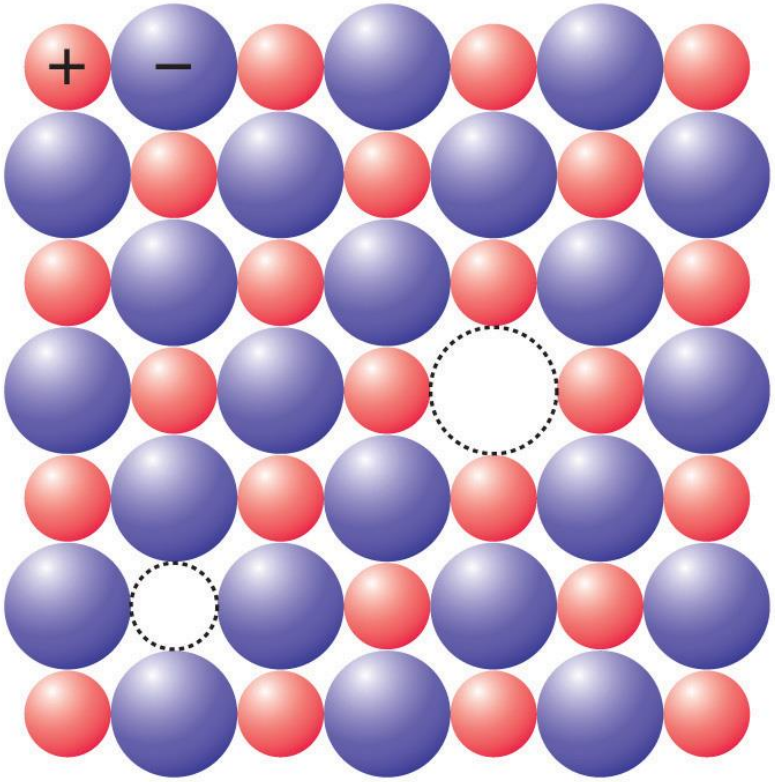
MoS2 monolayer

Mo substituted by S

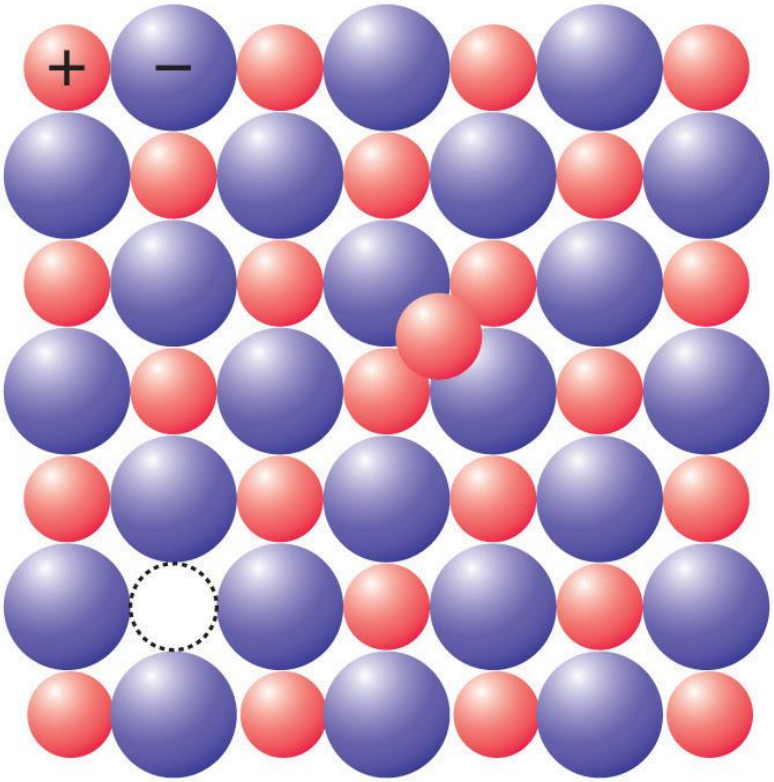
lack of S

scale 1 nm

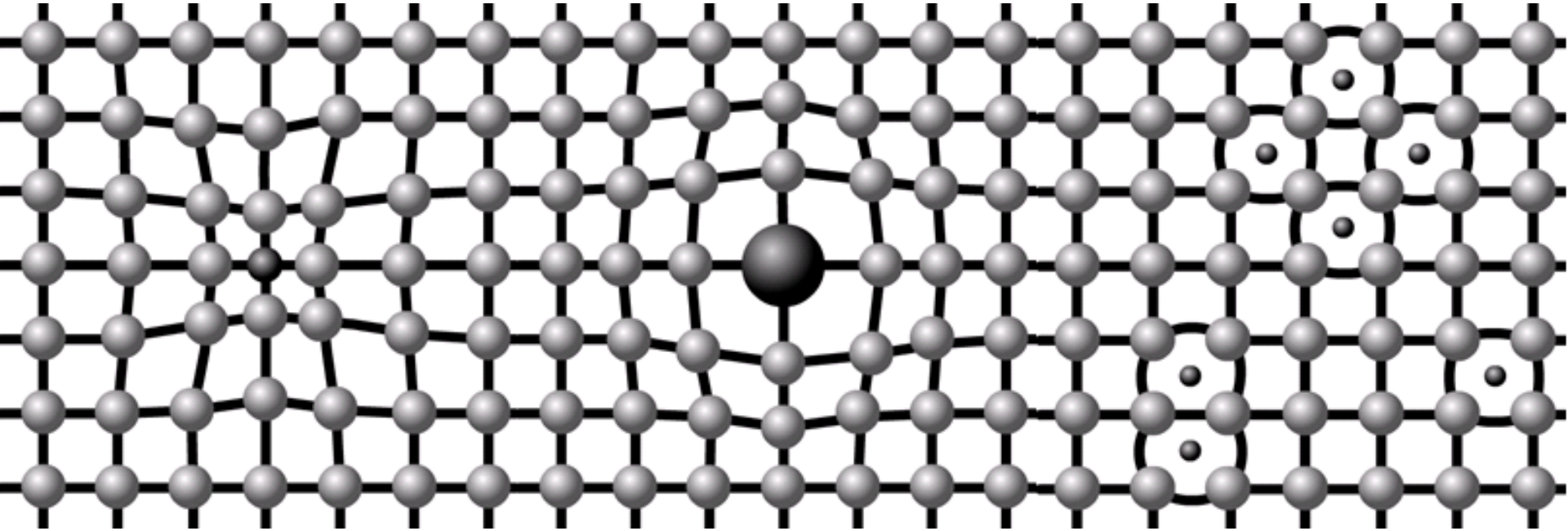
## paired defects



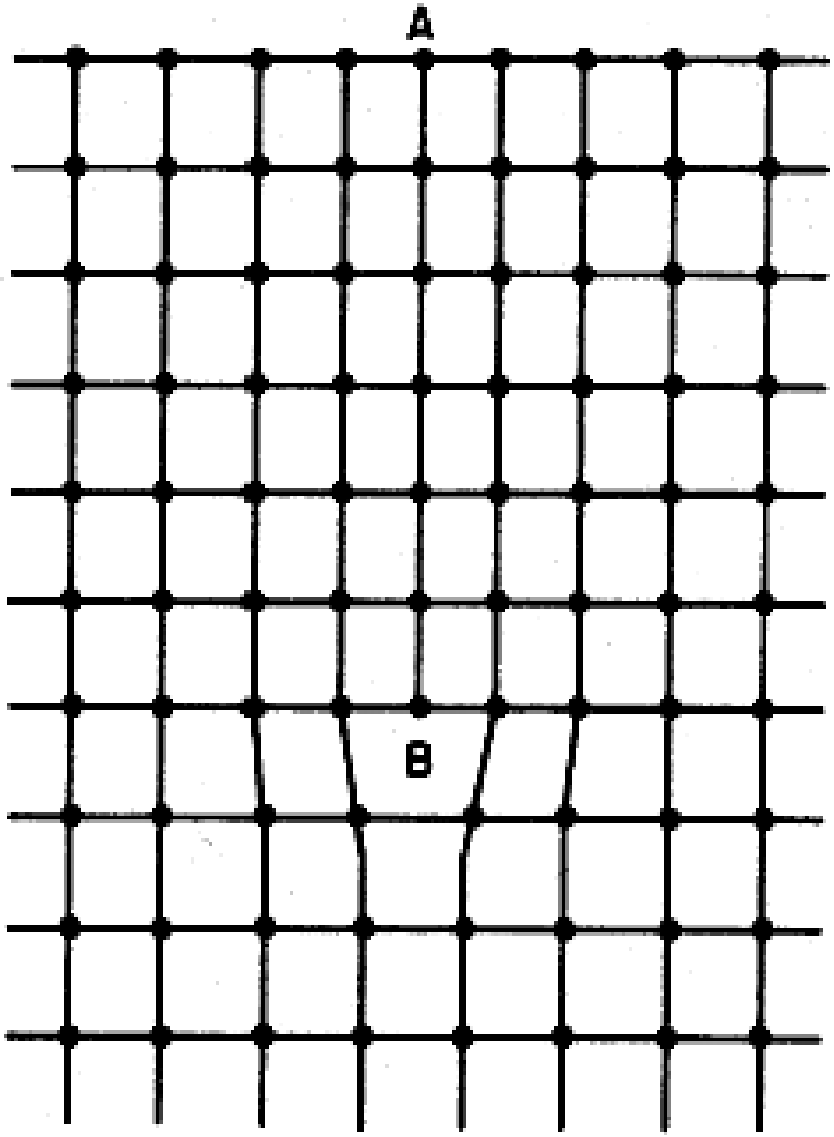

(a) Schottky defect




(b) Frenkel defect



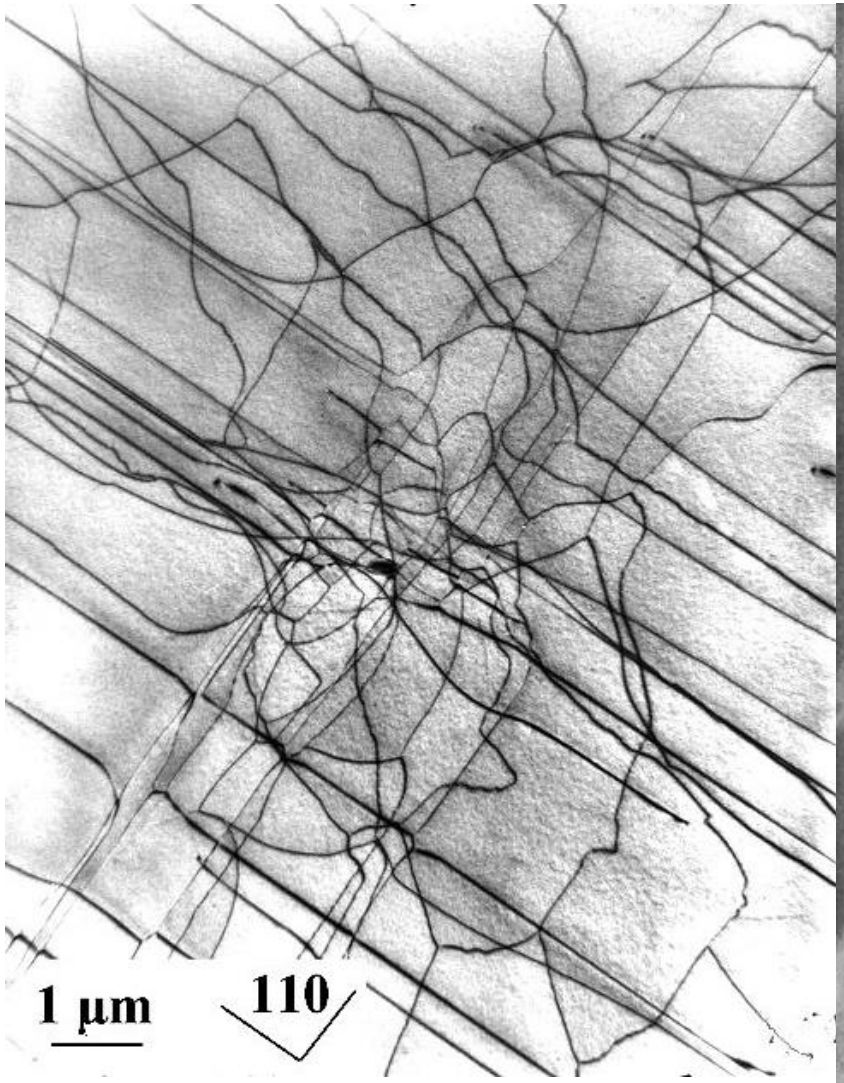
crystal defects result in **distortion of crystal lattice**

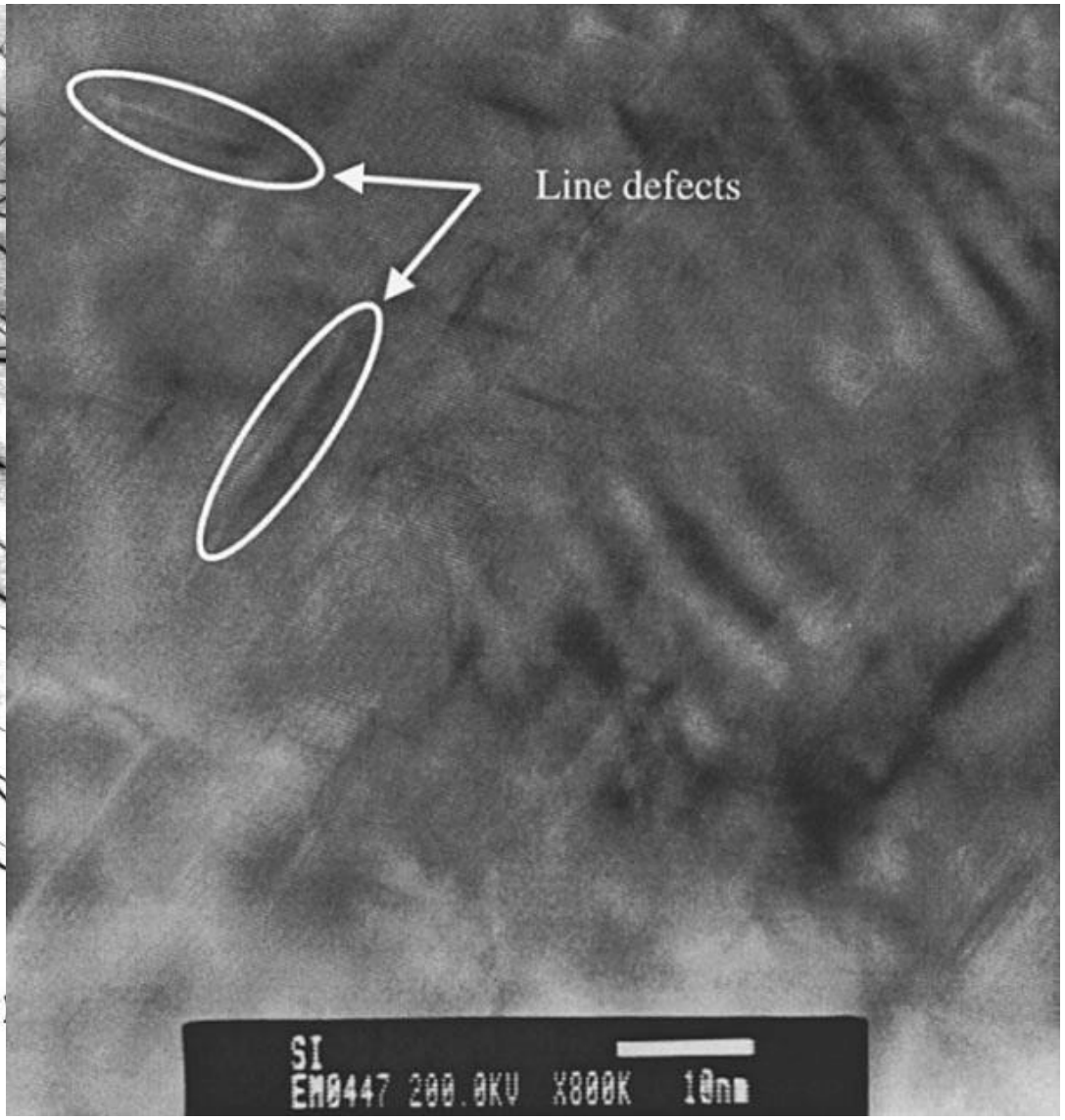


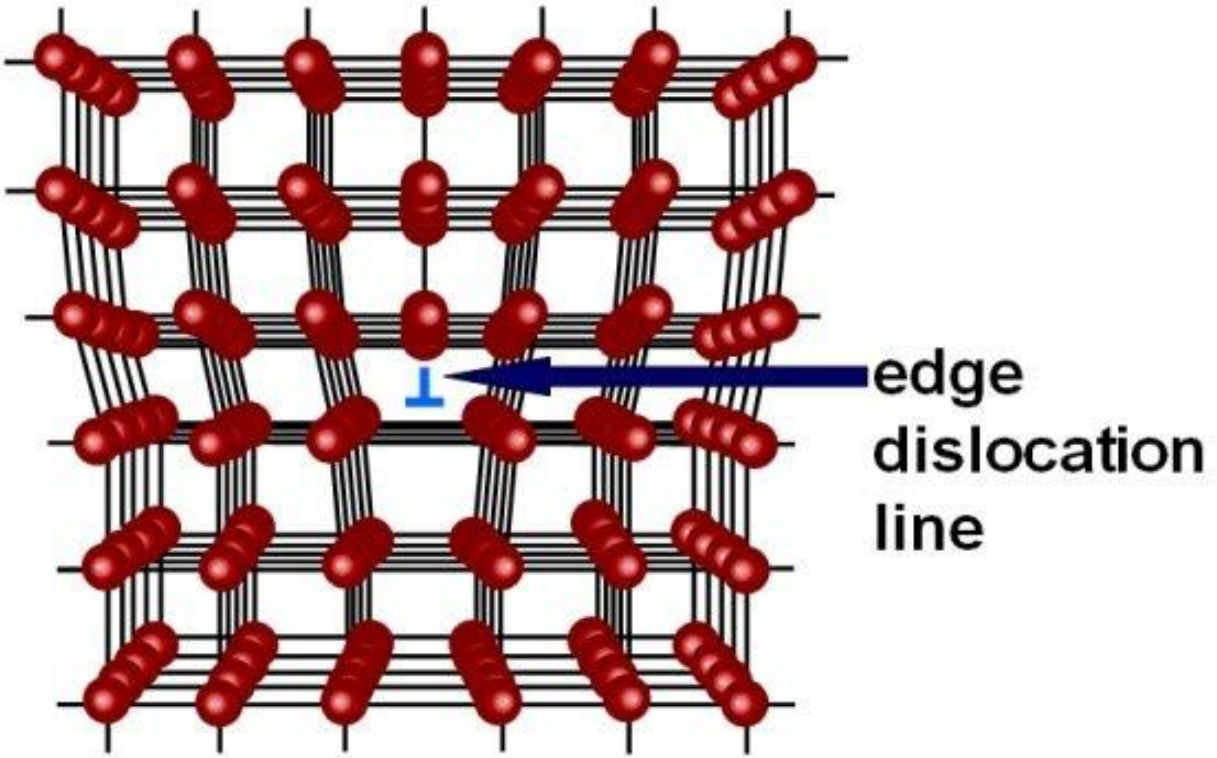

dislocation = linear defect

**TEM**

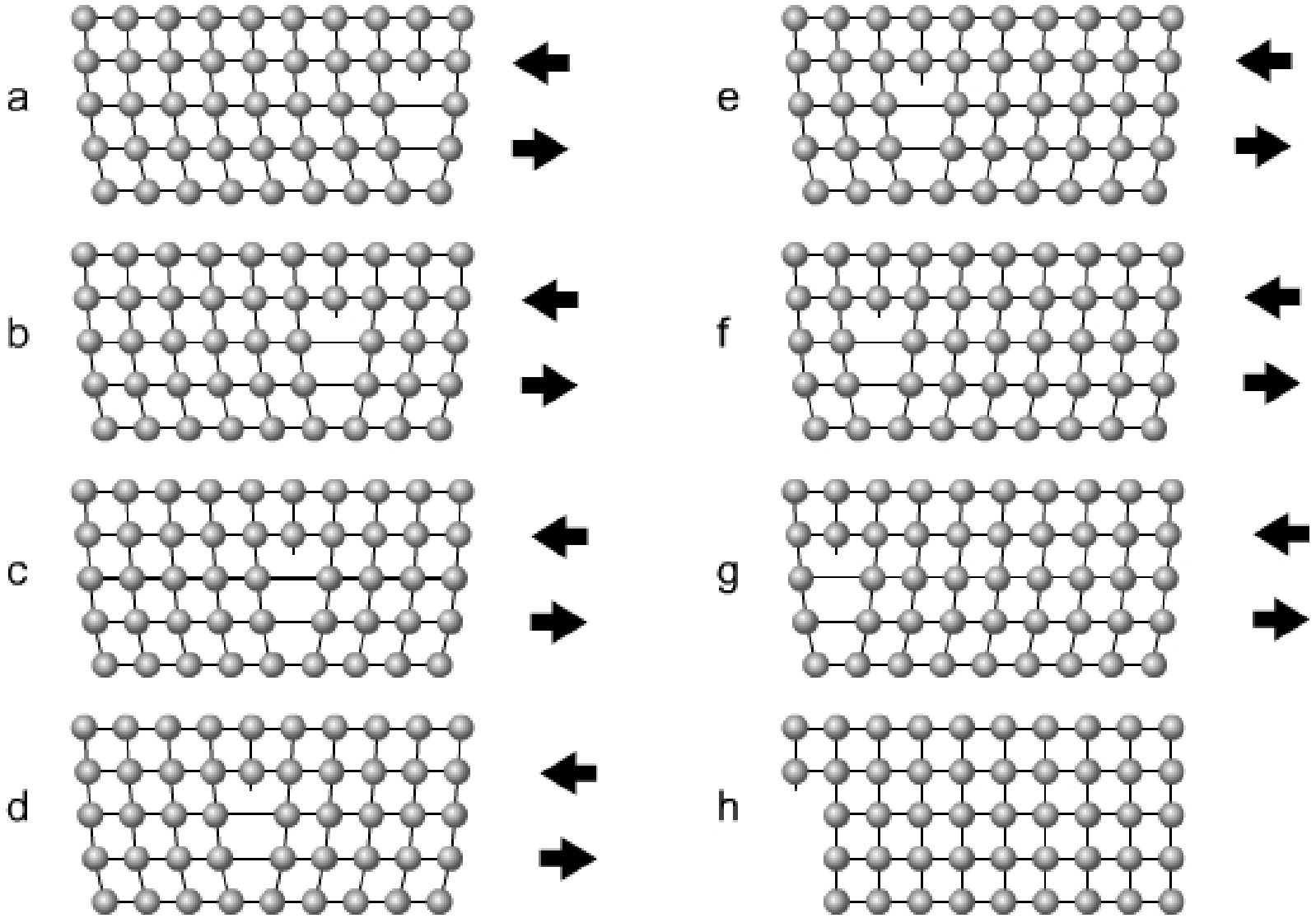
Si surface



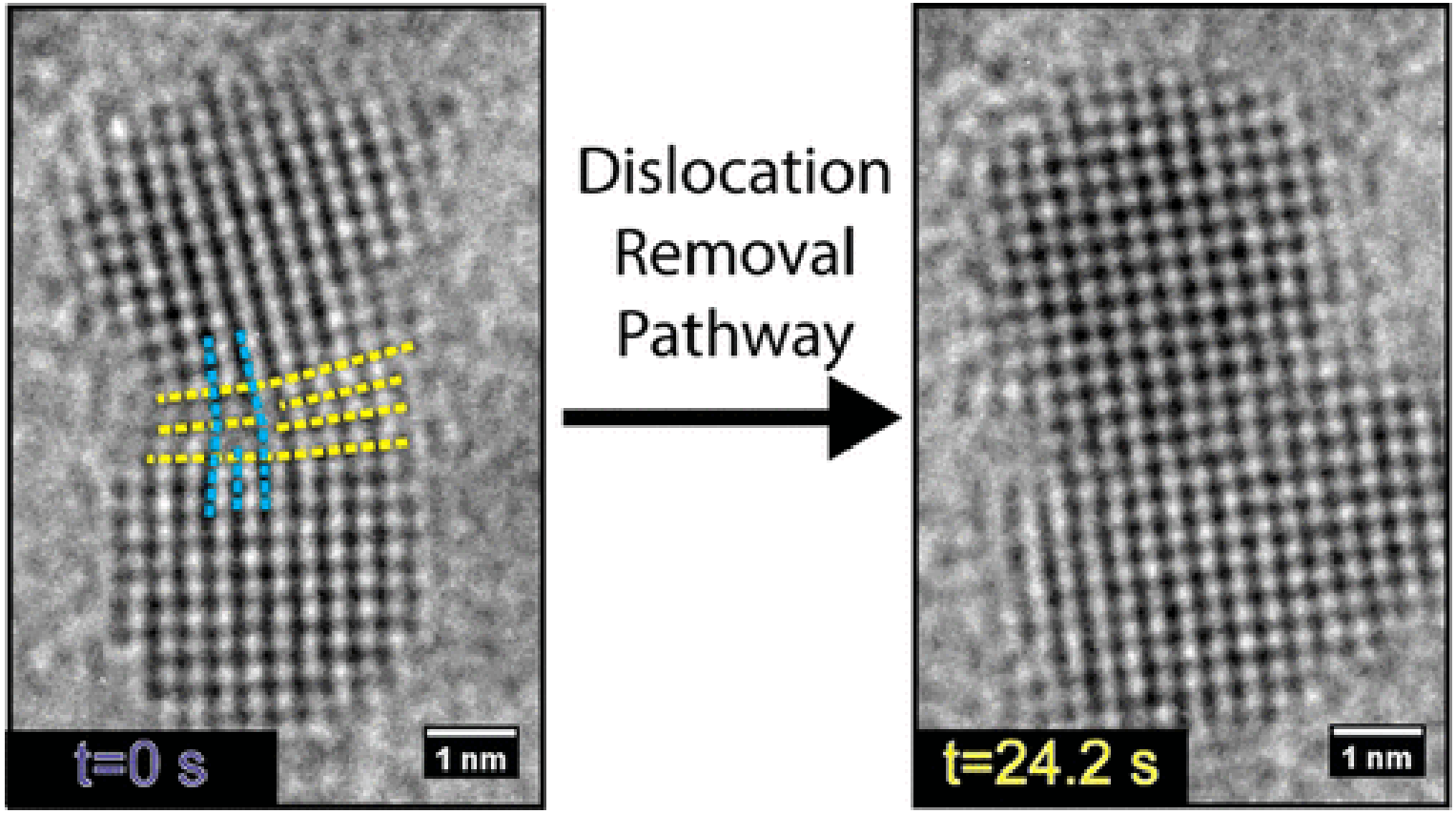


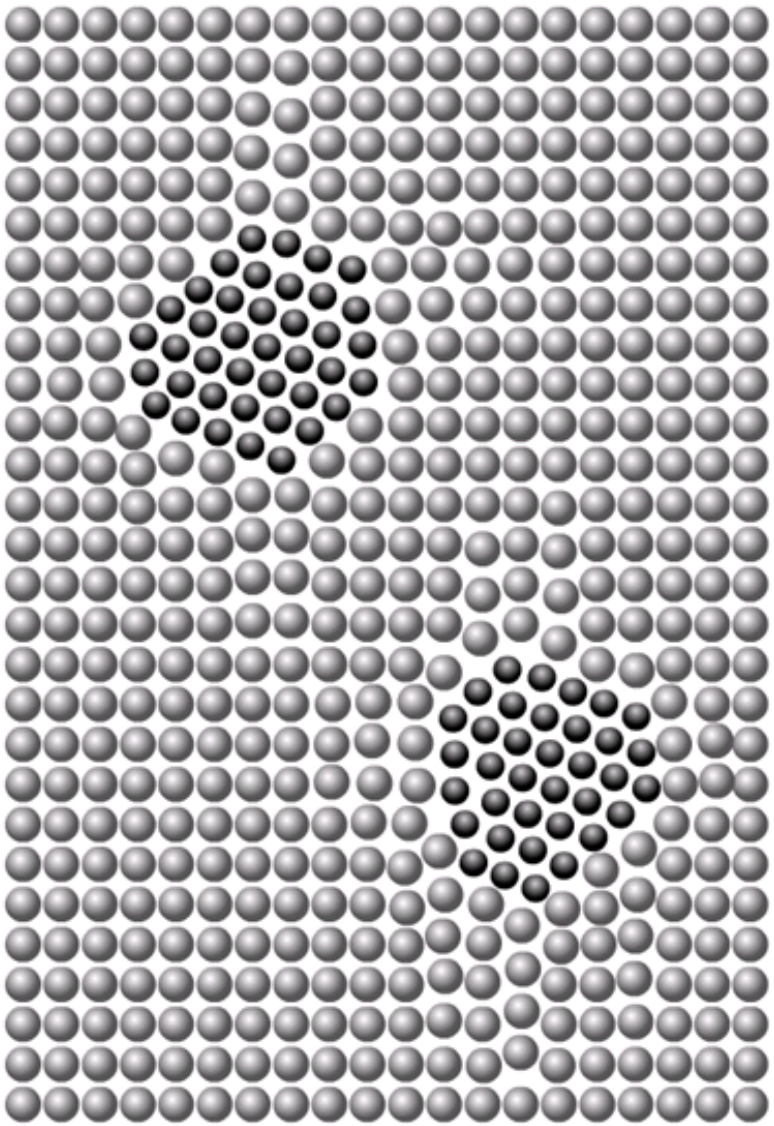

connected dislocations = **planar defects**

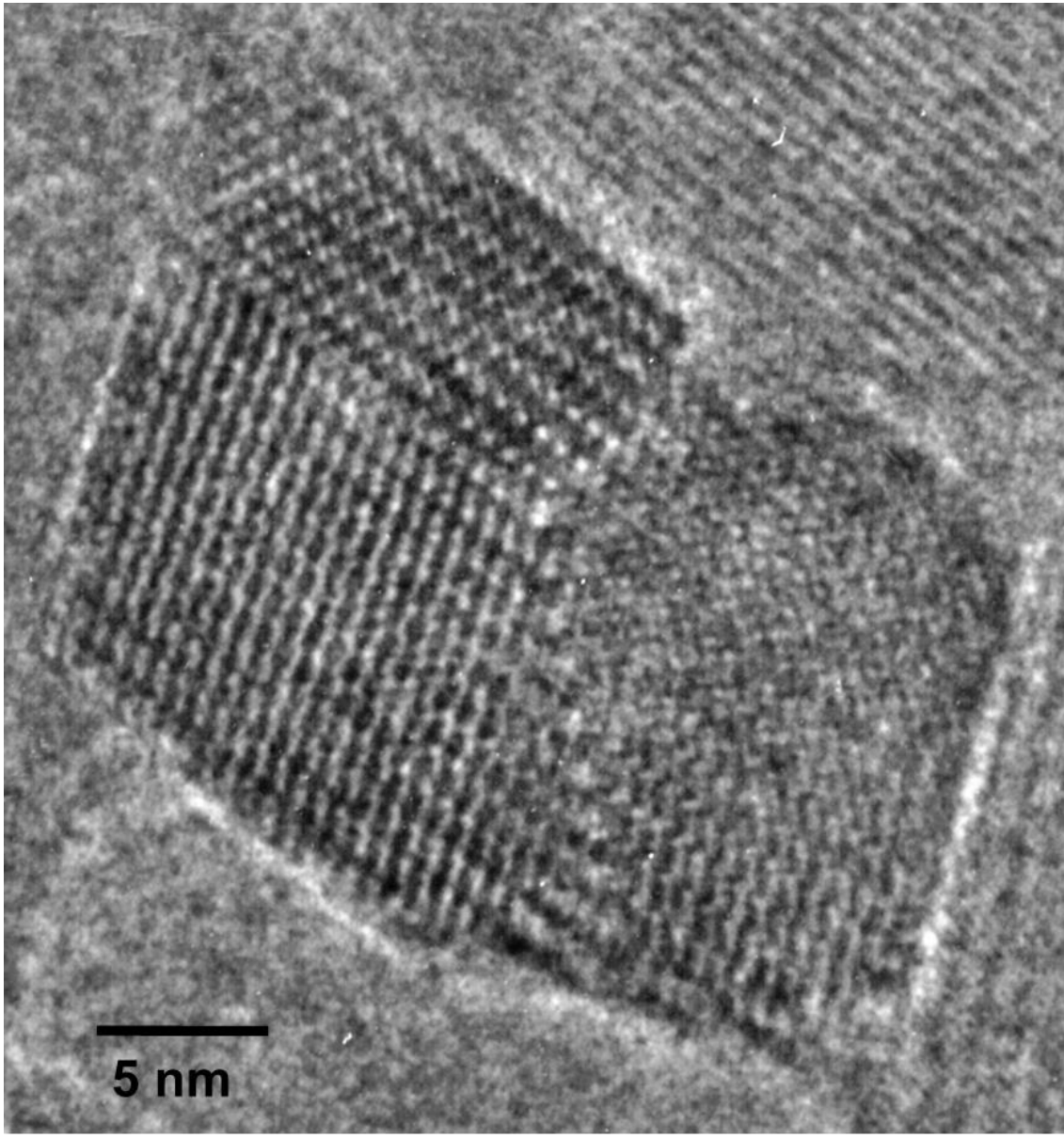



**dislocations move** in a crystal (at increased temperature)

## PbTe crystal








**defect clustering** above solubility threshold