Repetition of material concepts

Unit cell

Lattice

Vacancies

Solute atom

Interstitial atom

Edge dislocation

Screw dislocation

Cross slip

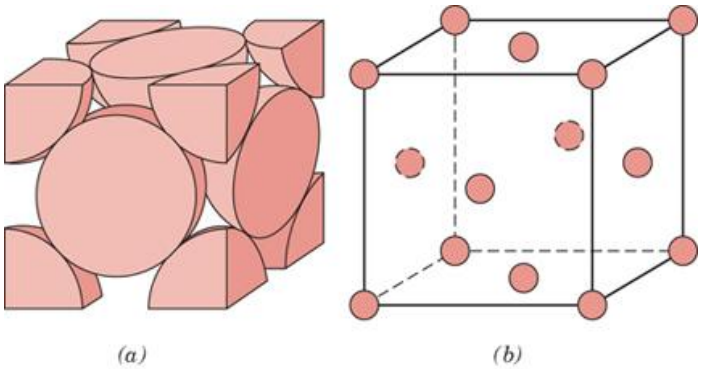
High angle grain boundary

Low angle grain boundary

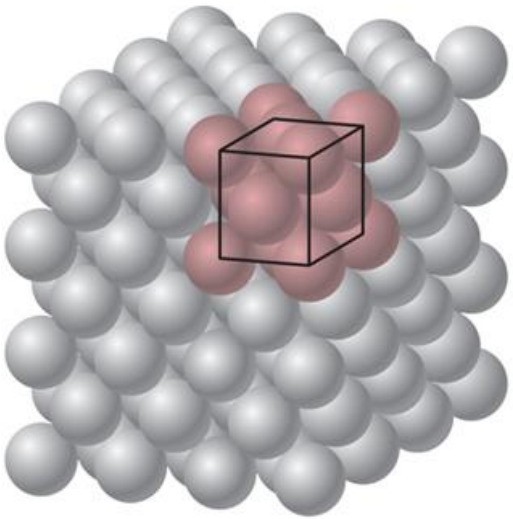
Twin boundary

Crystallography – unit cell

Different ways to illustrate how the atoms are positioned in a crystal



(a) (b)



(c)

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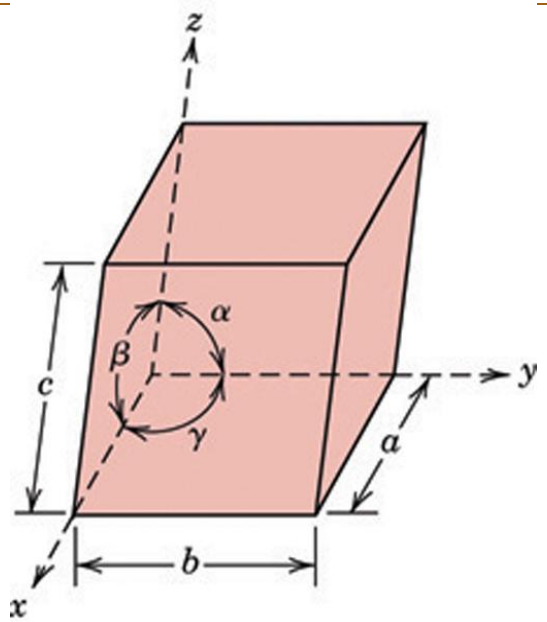
Crystallographic concepts

- **Unit cell**= smallest repeating unit in a crystal structure
- **Lattice**= Regular geometrical placement of points in the crystal, atom positions
- **Lattice constants**= lengths and angles describing the unit cell, se figures.



General Cristal (tetragonal)

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Disturbance in the crystal lattice

- Point defects, line defects, volume defects
- The defects causes disturbance in the
- By controlling the defects in the lattice many properties of the material can be increased and makes it possible to manufacture stronger material increases.

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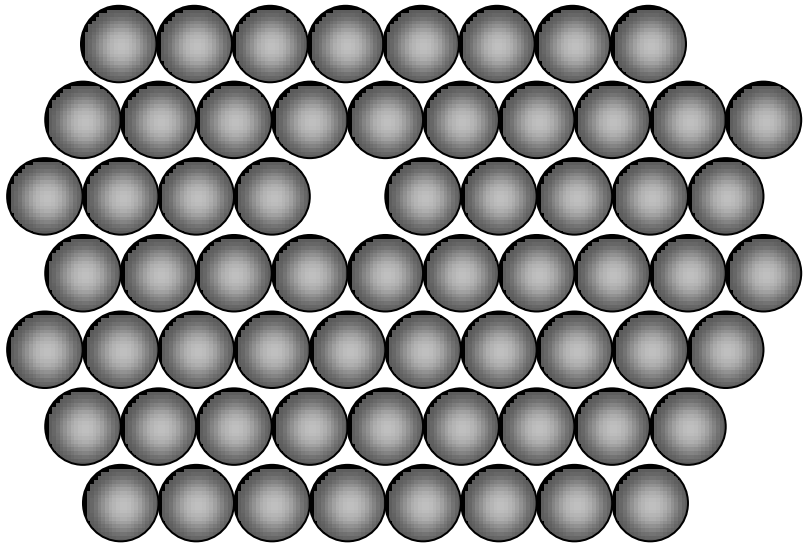
Point defect-Vacancy

A vacancy- a missing atom

Vacancies are introduced in the crystal during solidification, at high temperature are due to radiation.

The number increases exponentially with temperature.



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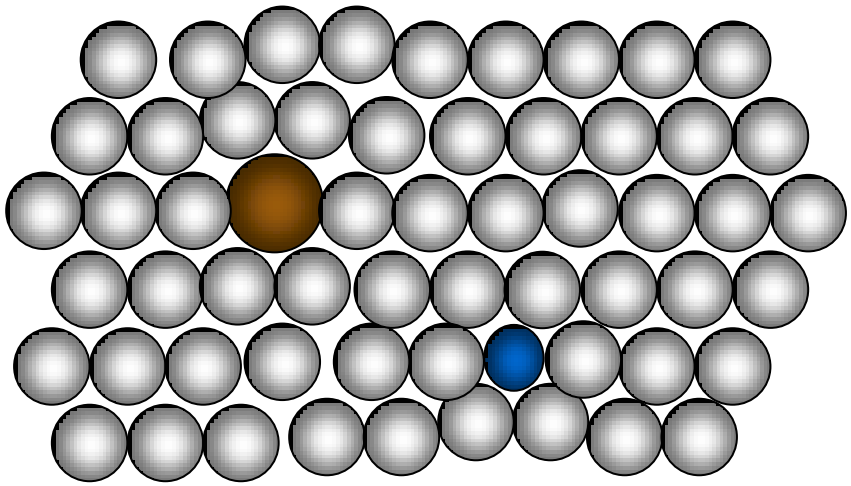
Point defect-Solute atoms

Solute atom–replace another atom

Can be larger or smaller than the lattice atoms

Distorts the perfect lattice



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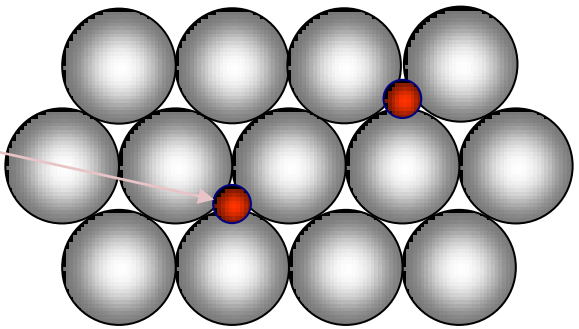
Point defects-Interstitial atom

An **interstitial** atom is introduced when an additional atom exists in the lattice.



Ex. Steel(<2wt% C) Carbon atoms is placed interstitially in the iron lattice

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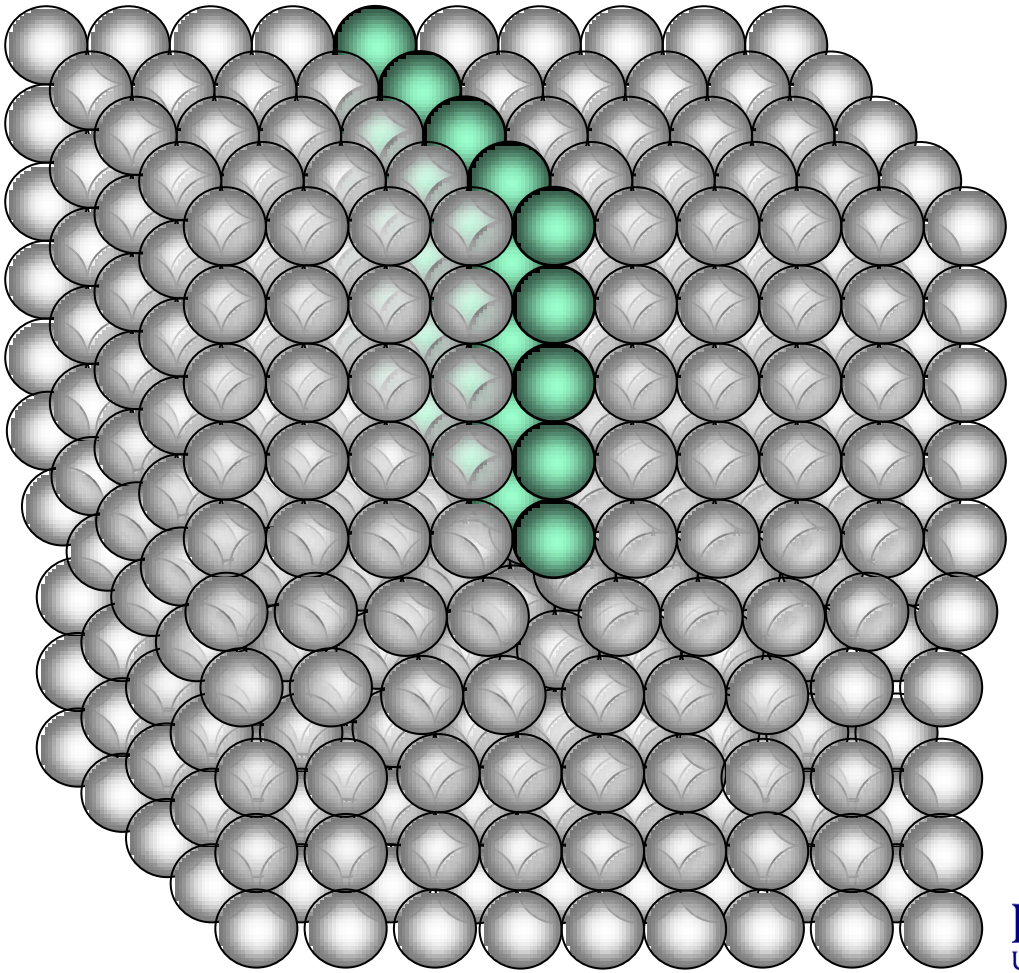
Line defects–dislocations

Edge dislocation



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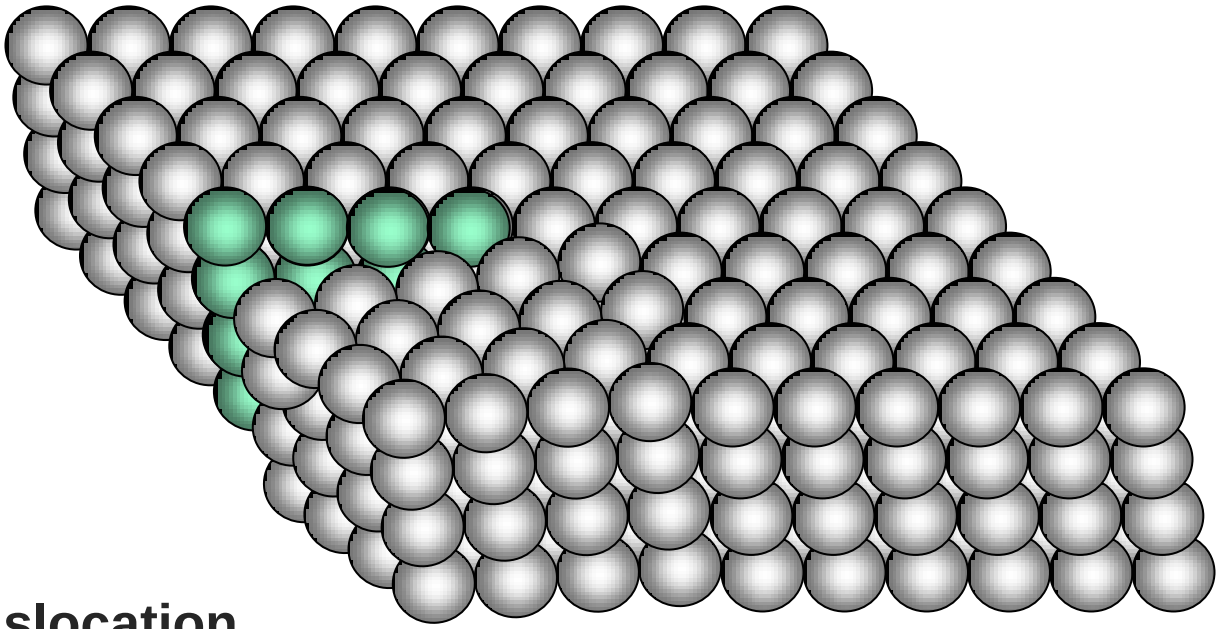
Line defects -dislocations



Screw dislocation

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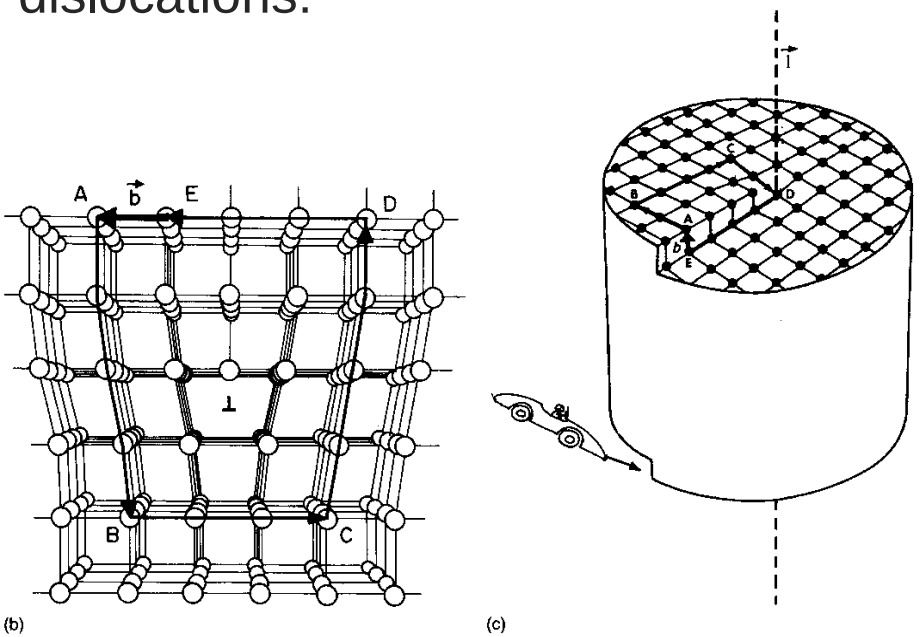
Line defects-dislocations

Two types of dislocations:

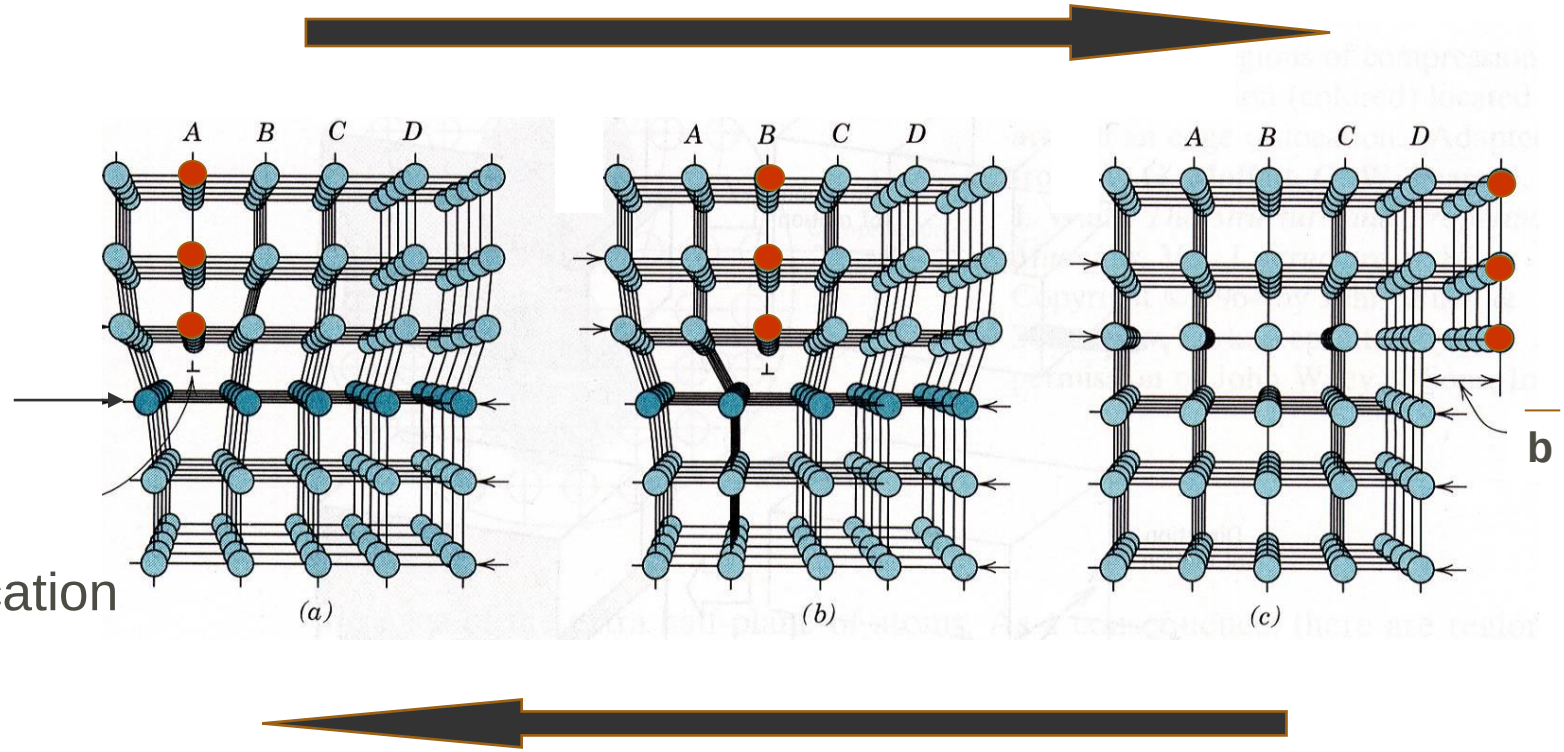


Edge dislocation:

Extra atomic plane pushed into the lattice

Screw dislocation:

How does a dislocation move?

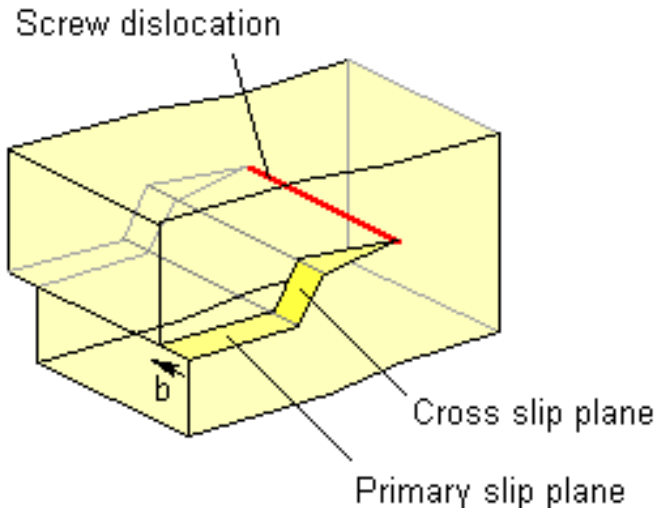


Edge dislocation

Shear stress

Burgers vector, **b**

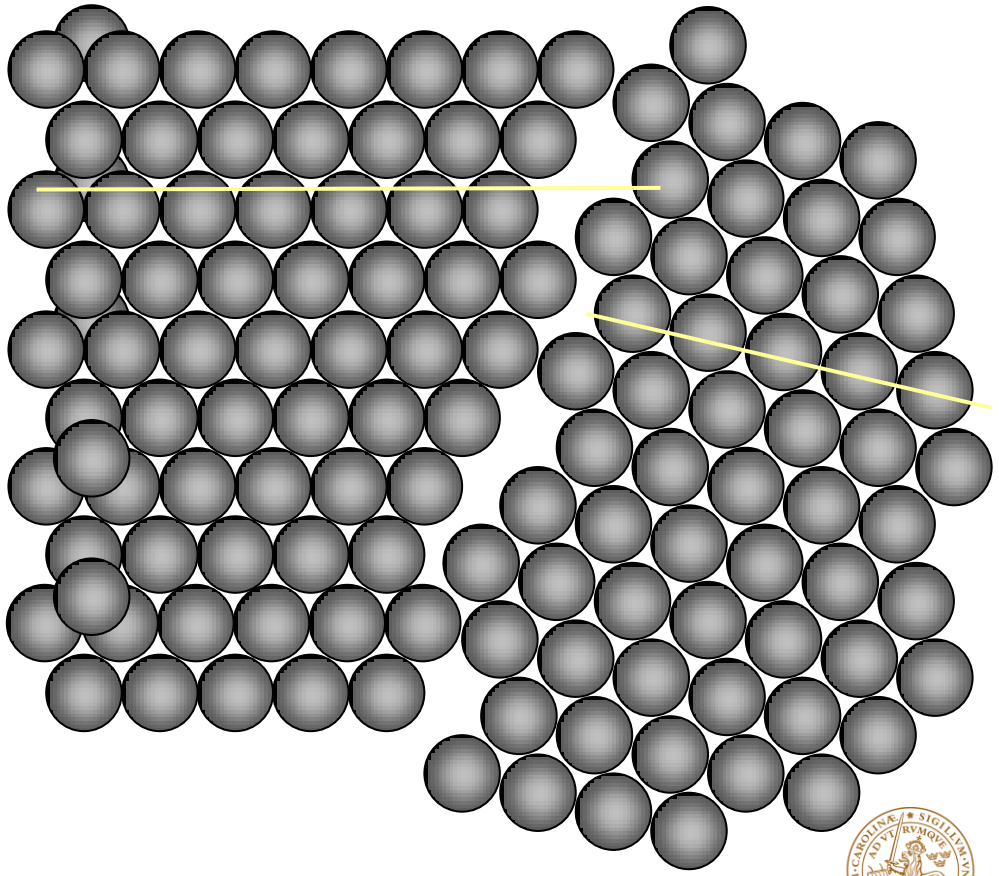
Cross slip, screw dislocation



High angle grain boundary

The material structure of metals consists of grains.

The atomic arrangement in a lattice extends in one direction and several lattices extends in different directions relative each other.



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Low angle grain boundary

An array of dislocations that produces a small misorientation between adjacent lattices.

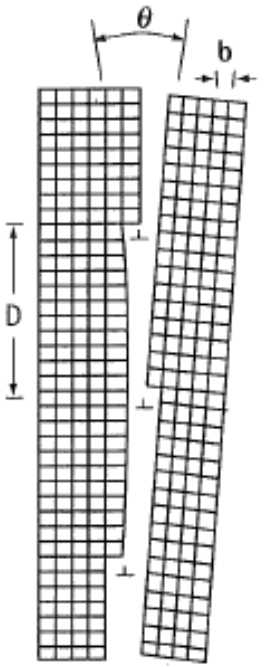

Figure 4.17
The small angle grain boundary is produced by an array of dislocations, causing an angular mismatch θ between the lattices on either side of the boundary.

Twin boundary

A plane across which there is a special mirror image misorientation of the lattice structure

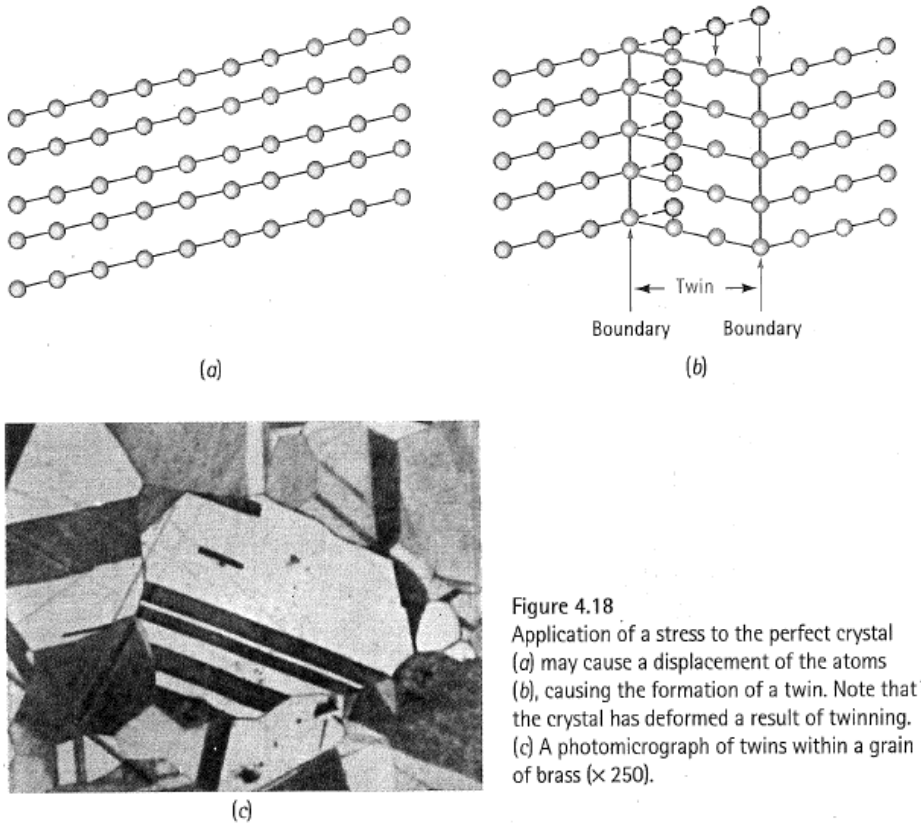

Figure 4.18
Application of a stress to the perfect crystal (*a*) may cause a displacement of the atoms (*b*), causing the formation of a twin. Note that the crystal has deformed a result of twinning. (*c*) A photomicrograph of twins within a grain of brass (× 250).

The science and engineering of materials, Askeland.

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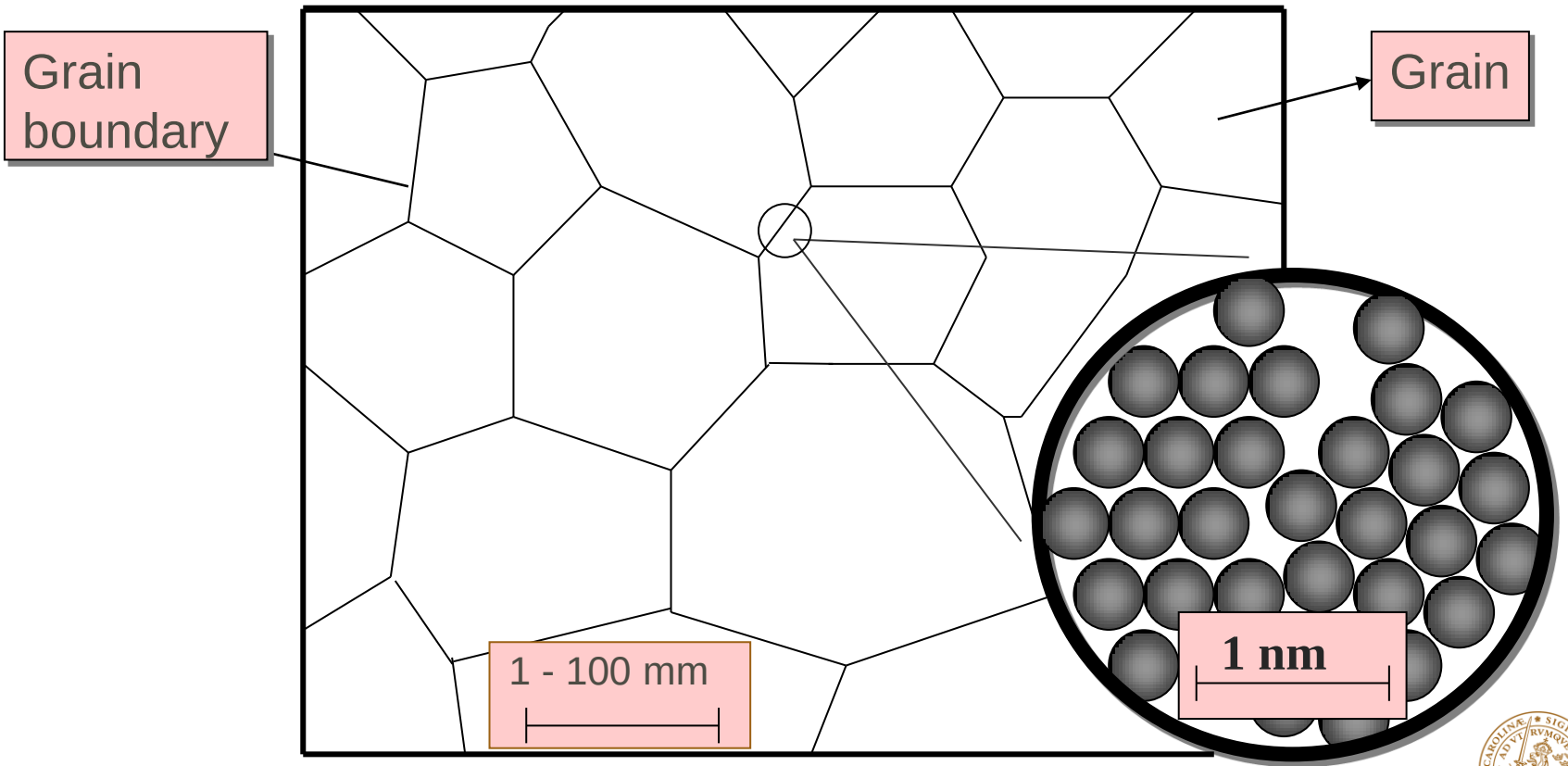
Polycrystalline microstructure



Grain= part of a crystalline material where the crystal orientation is uninterrupted.

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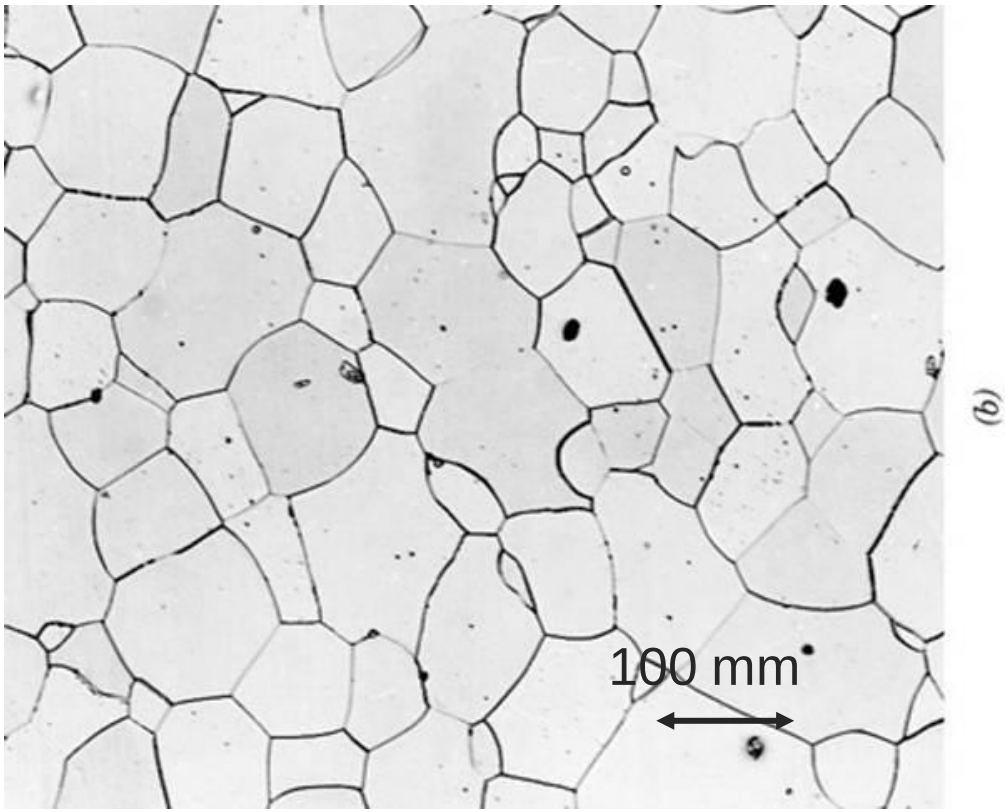
Microstructure



Grain and grain boundaries in a stainless steel.

(Picture taken using an optical microscope)

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Polycrystal

Most construction metals are polycrystalline, built up by many grains.

(Picture taken using an optical microscope)

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