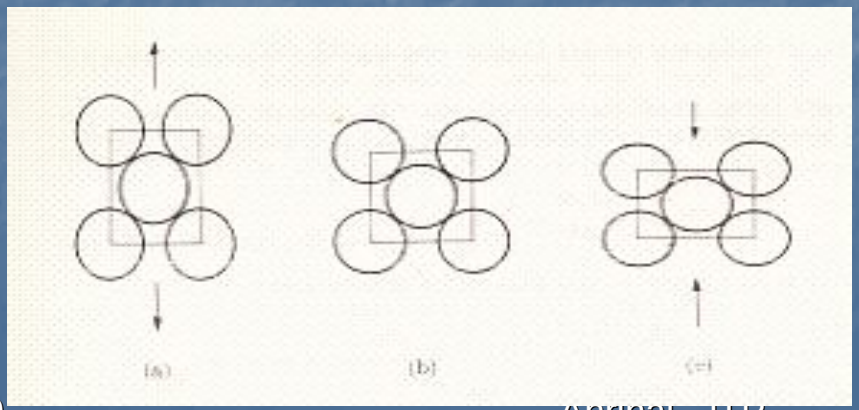
METALURGI FISIK

Deformasi

Deformasi

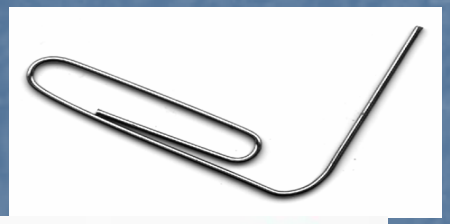
Deformasi merupakan perubahan bentuk / ukuran logam karena adanya gaya luar yang diberikan atau karena transformasi fasa dan pembekuan.

1. Deformasi Elastis
2. Deformasi Plastis



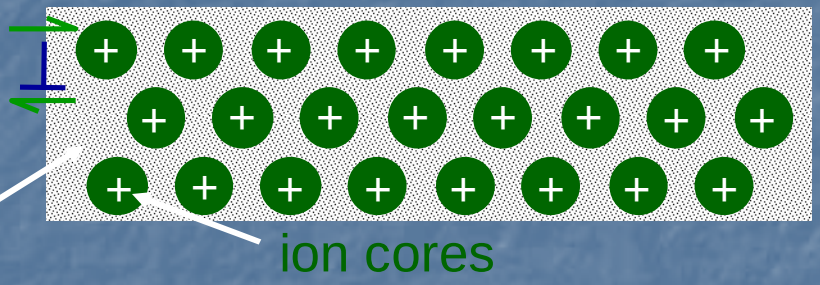
Solid Mechanics Vocabulary

- Elastic:
  recoverable deformation
- Elastic-Plastic:
  recoverable + permanent deformation
- Localized failure

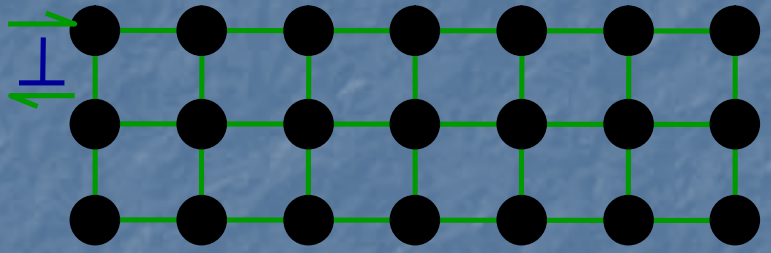


Dislocations & Materials Classes

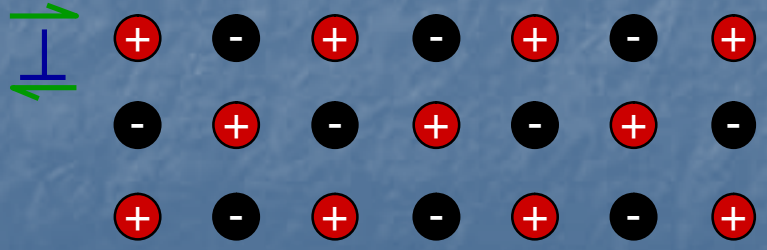
- Metals: Disl. motion easier.
  - -non-directional bonding
  - -close-packed directions for slip.



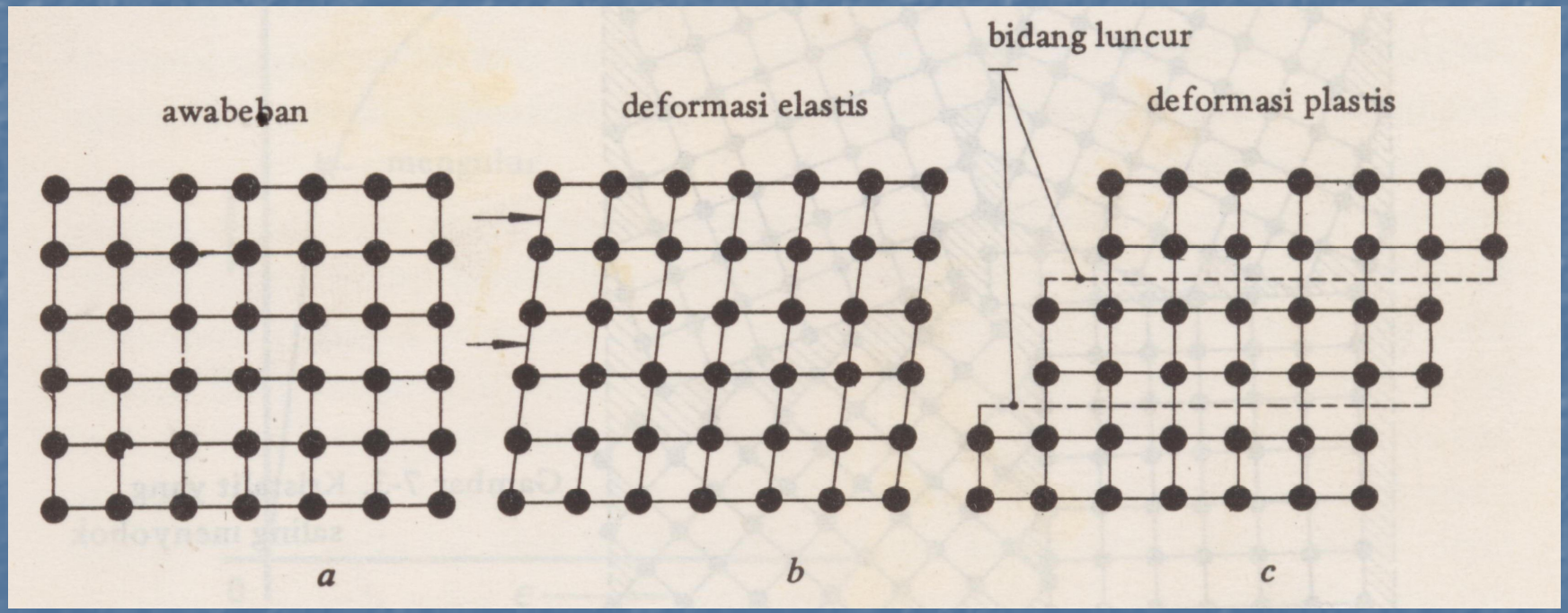
- Covalent Ceramics (Si, diamond): Motion hard.
  - -directional (angular) bonding



- Ionic Ceramics (NaCl): Motion hard.
  - -need to avoid ++ and - - neighbors.



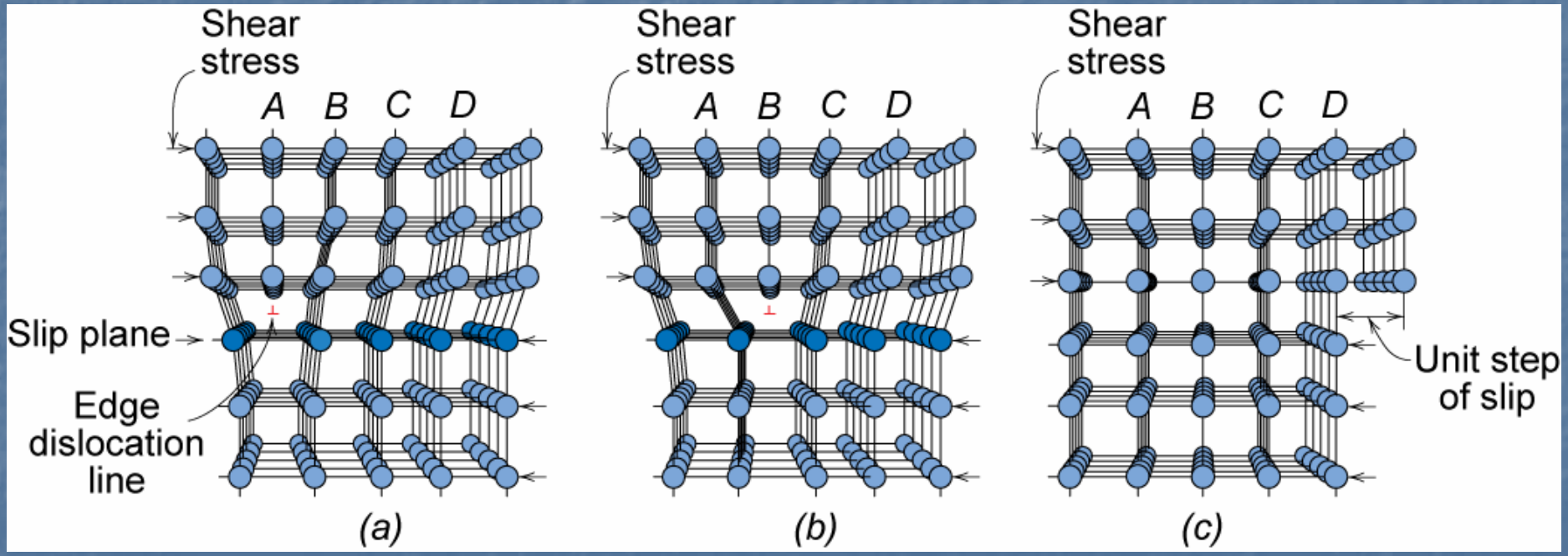
Pengaruh Beban Terhadap Struktur



Dislocation Motion

Dislocation motion & plastic deformation

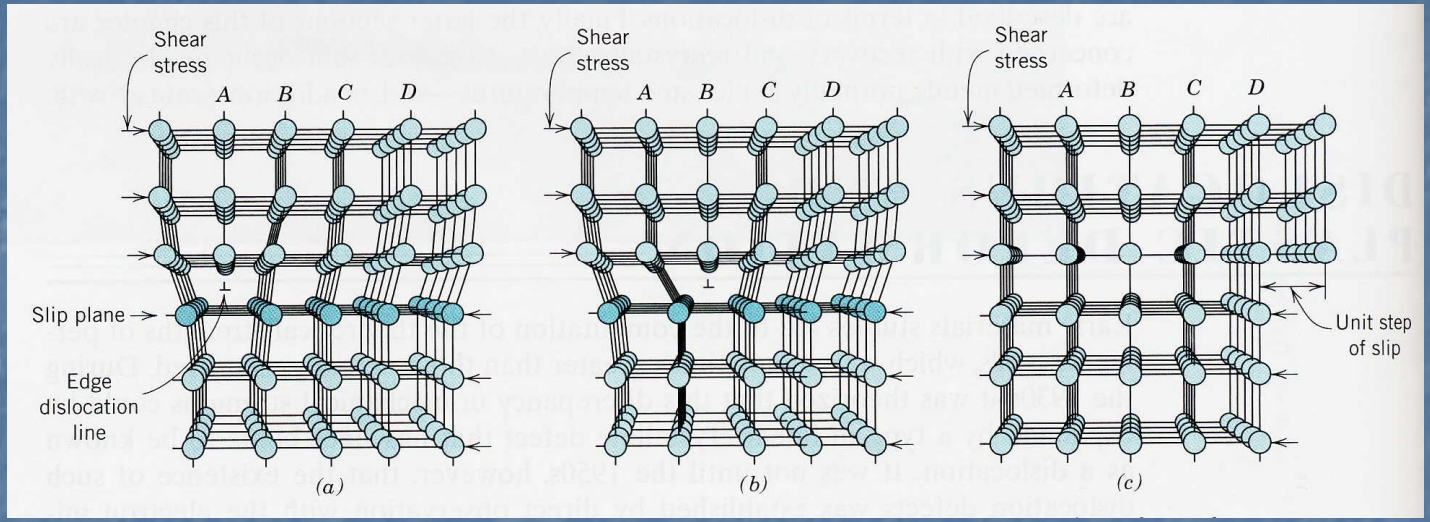
- **Metals - plastic deformation occurs by slip – an edge dislocation (extra half-plane of atoms) slides over adjacent plane half-planes of atoms.**



Adapted from Fig. 8.1, *Callister & Rethwisch 3e.*

- If dislocations can't move, plastic deformation doesn't occur!

Analogy of Dislocation Motion



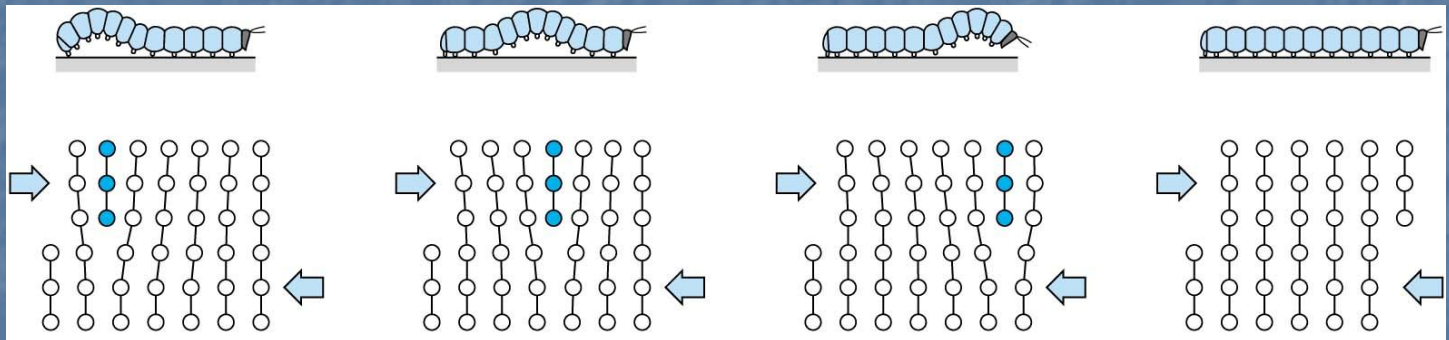
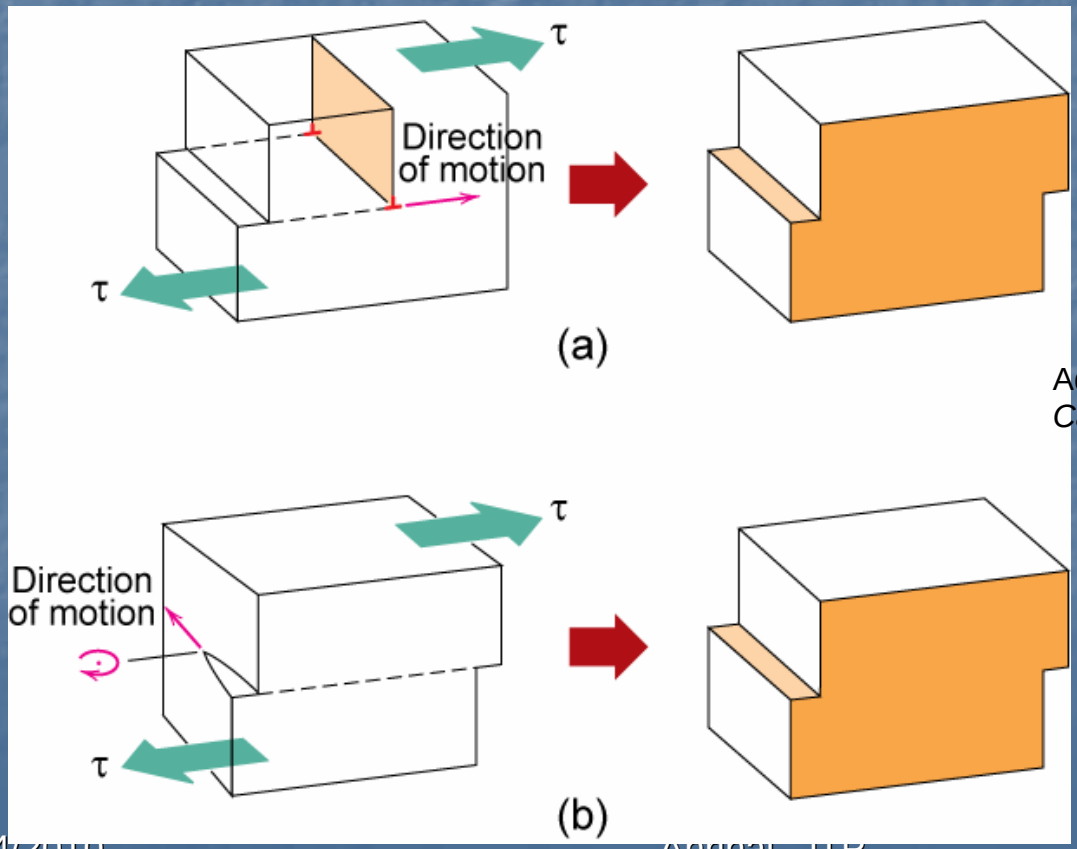


FIGURE 7.3 Representation of the analogy between caterpillar and dislocation motion.

Dislocation Motion

- A dislocation moves along a slip plane in a slip direction perpendicular to the dislocation line
- The slip direction is the same as the Burgers vector direction

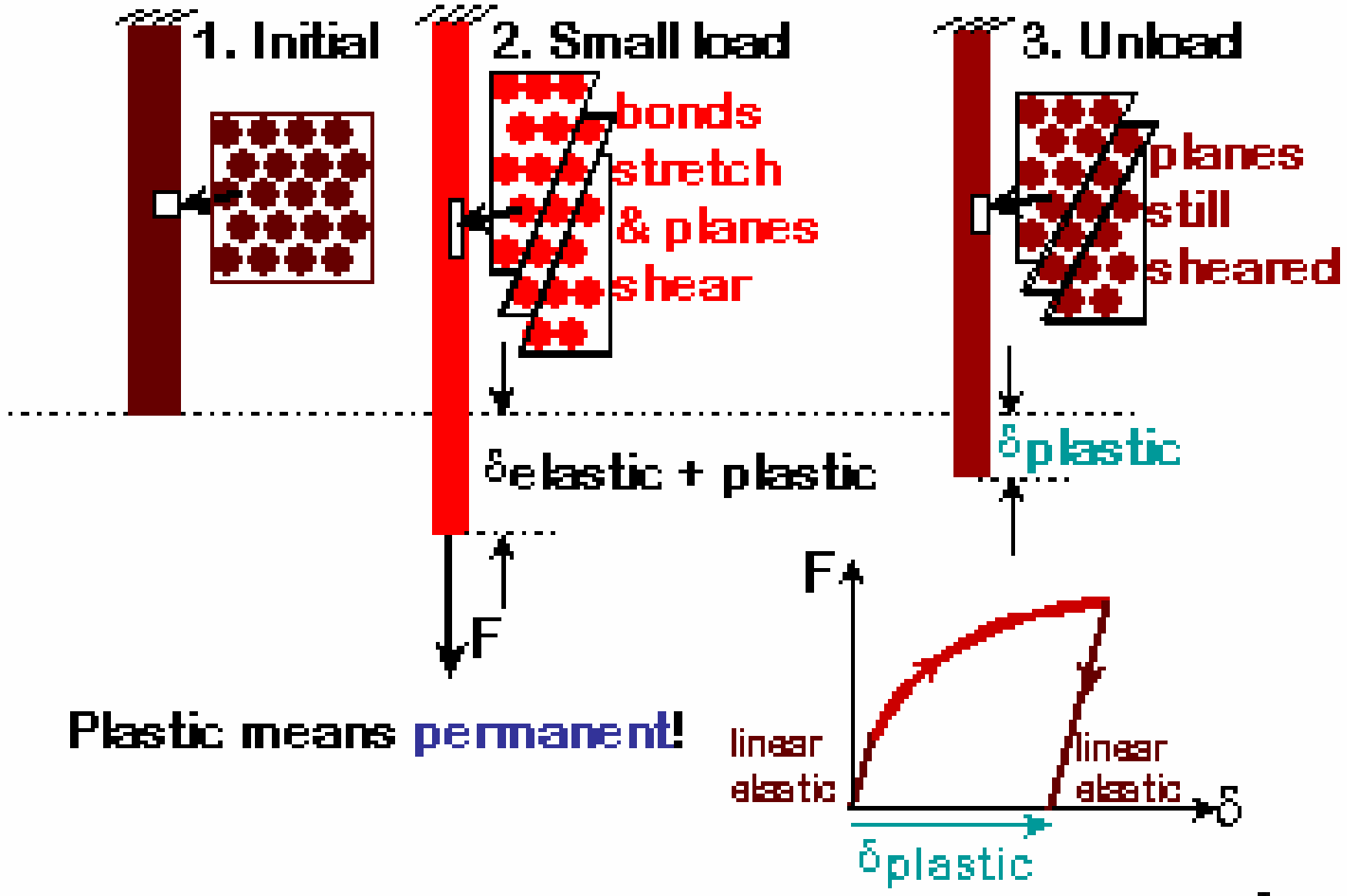


Edge dislocation

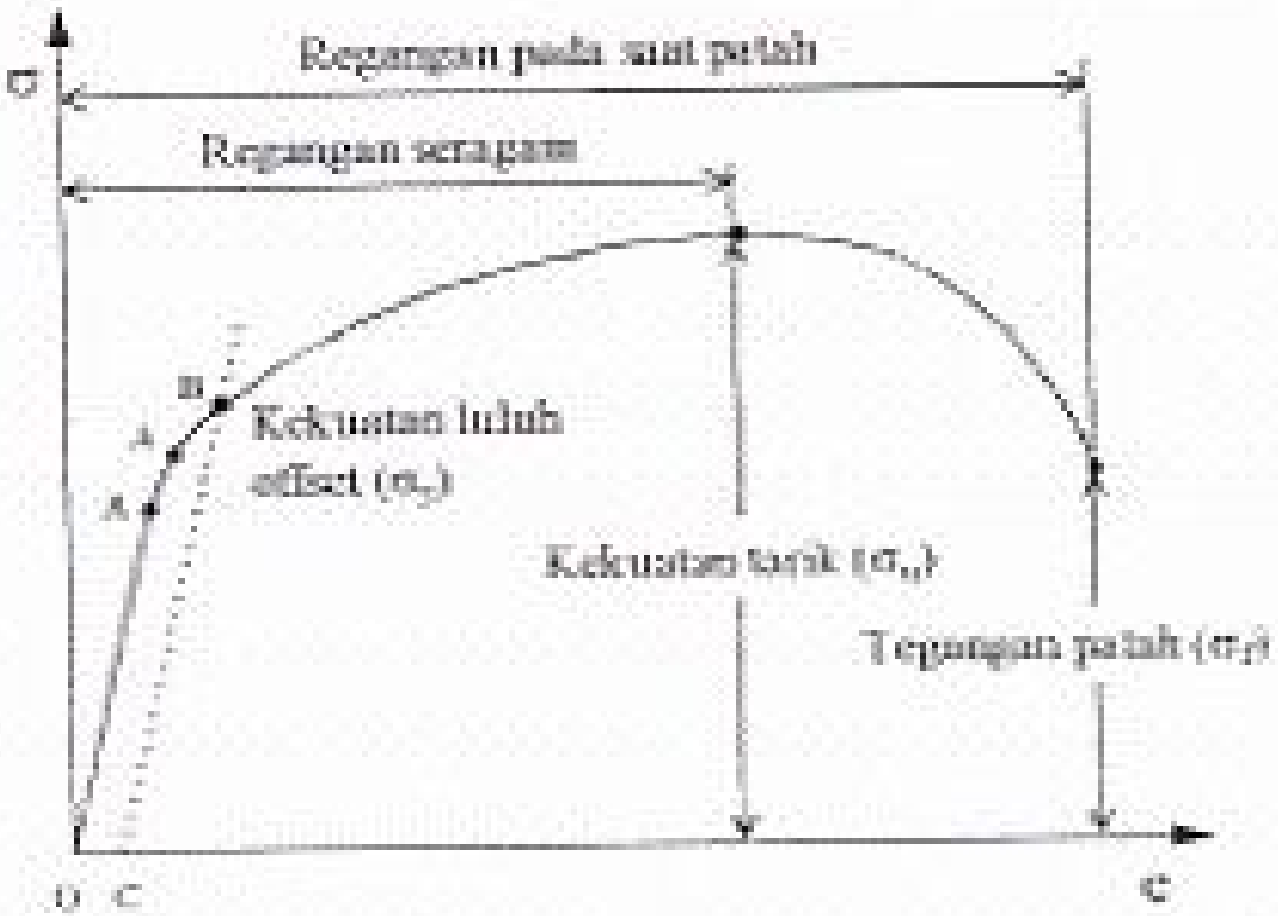
Adapted from Fig. 8.2,
Callister & Rethwisch 3e.

Screw dislocation

Plastic Deformation (Metals)

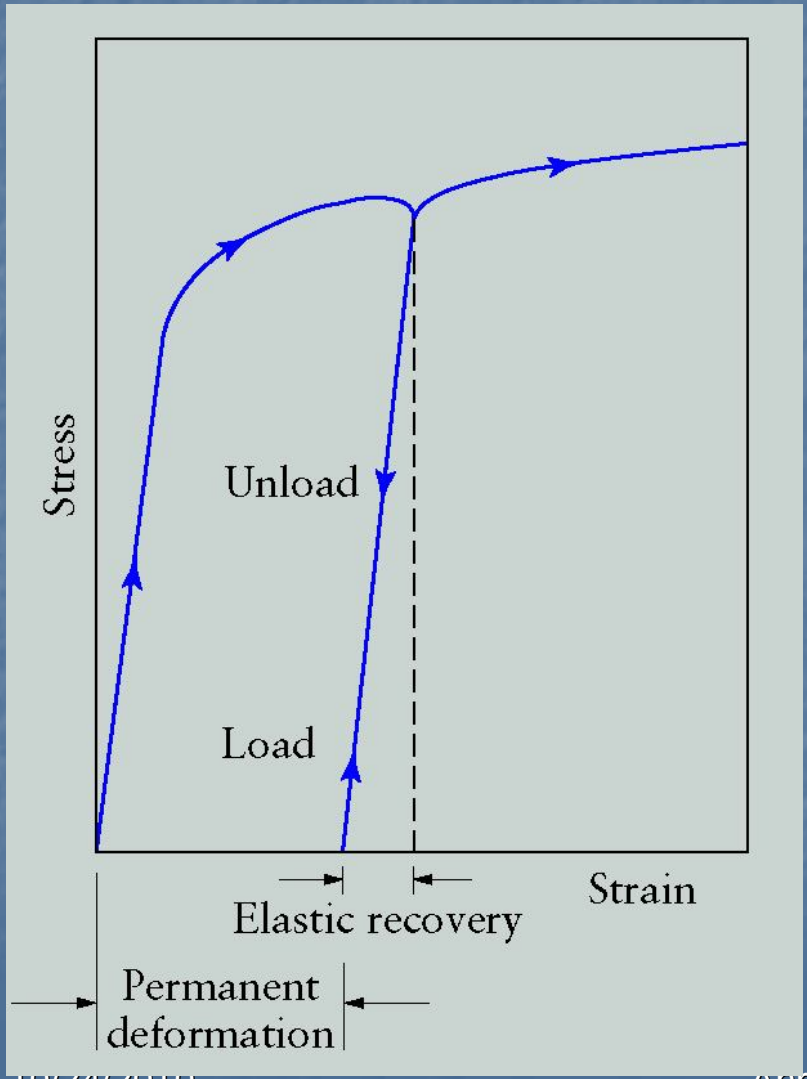


Plastic means permanent!



Kurva tegangan-regangan suatu material

Effects of Cold Working



Schematic illustration of loading and unloading of a tensile-test specimen. Note that yield stress increases and ductility decreases with prior cold work.

Metal Working Classification based on Temperature

- Cold Working: working at room temperature, $T<0.3T_m$.
  - Advantages: no oxidization, tighter tolerances, better surface finish, thinner walls, higher strength, easier lubrication.
  - Disadvantages: high tool pressures, deformation forces, equipment power, low material ductility.
- Hot Working: working with preheated materials, $T>0.5T_m$.
  - Advantages: force and power requirements low, ductility high
  - Disadvantages: takes extra energy to heat the workpiece, oxidization, impaired surface finish, wide dimensional tolerances.
    - Nonisothermal forming: tool much colder than workpiece.
    - Isothermal forming: tool same temperature as workpiece.
- Warm Working: in between cold working and hot working $0.3T_m<T<0.5T_m$

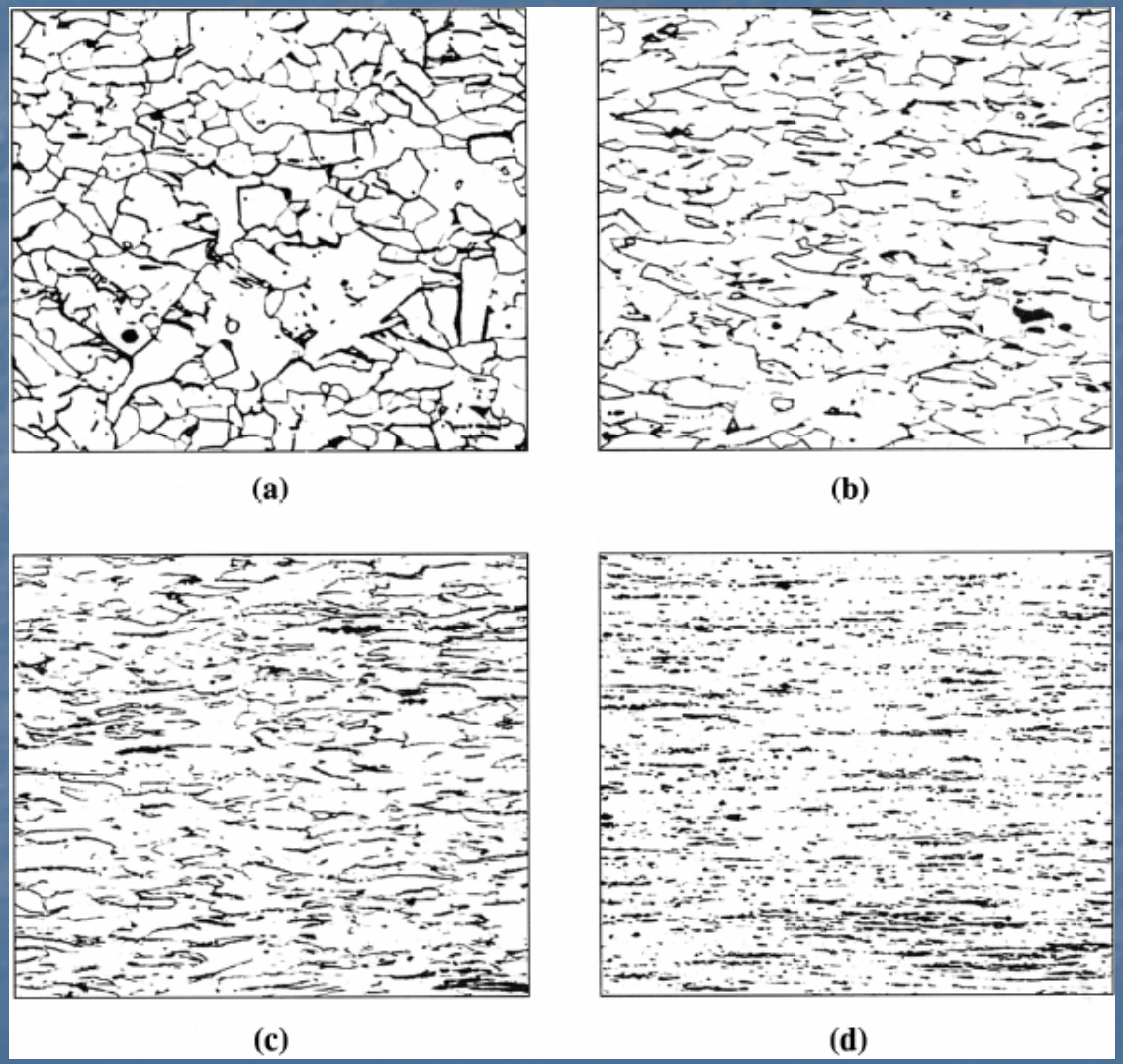


Figure 7.9 The fibrous grain structure of a low carbon steel produced by cold working: (a) 10% cold work, (b) 30% cold work, (c) 60% cold work, and (d) 90% cold work (250). (Source: From ASM Handbook Vol. 9, Metallography and Microstructure, (1985) ASM International, Materials Park, OH 44073. Used with permission.)