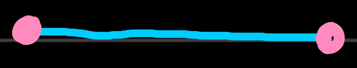
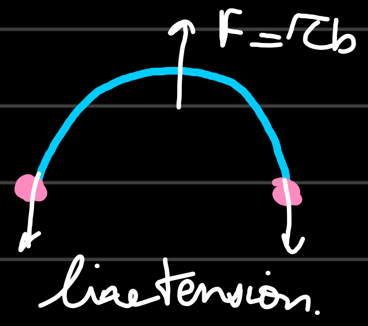
Lecture 15

Dislocation Sources:

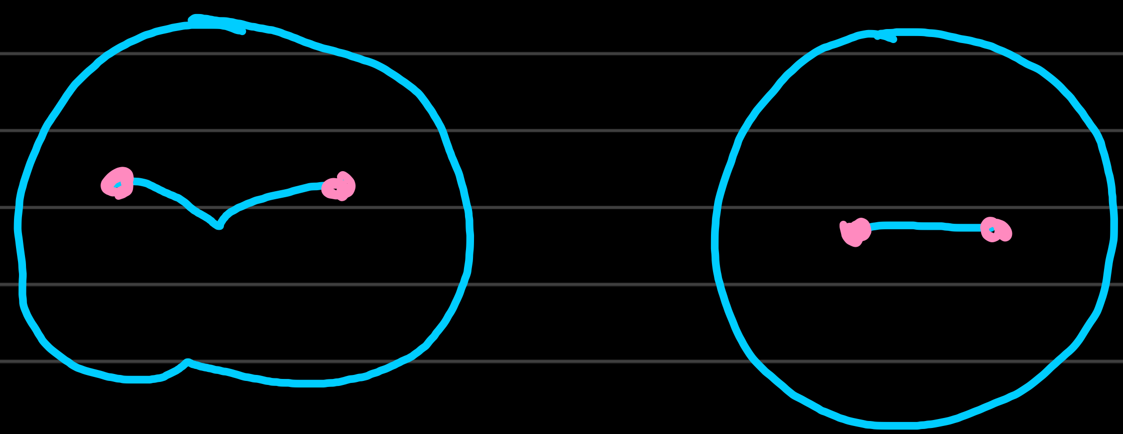
i> shear stress exerts $F = \tau b$ on dislocation line which is pinned on both ends.

$\boxed{\text{\{Frank-Reed Source\}}}$



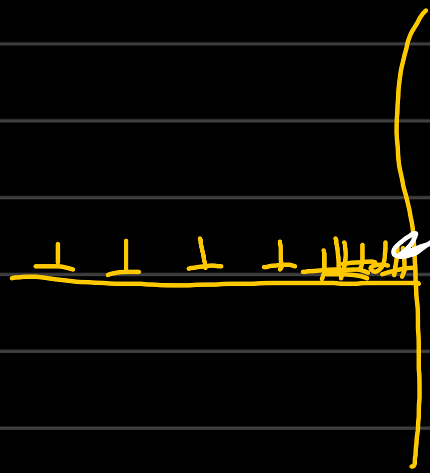


→ shear stress maximum when segment becomes semicircle.



→ series of concentric dislocation loops are formed

Dislocation grain boundary interaction



→ The pile-up causes high stress concentration

If pile up stress > theoretical shear stress.

↳ local yielding will take place.

→ pile-up of n dislocations along a distance L can be considered a giant dislocation with Burgers vector $\underline{\underline{nb}}$.

↳ Breakdown of a barrier occur by:

i) slip on new plane

ii) climb of dislocation around the barrier.

iii) generation of high enough tensile stress to produce a crack.

→ compared to single crystals, poly-crystals tend to have higher yield stresses.

→ Each grain in the poly-crystals has to undergo a complex shape change.

✲ mean free path of dislocation :

Dislocation-solute interaction :

↳ in solid solution phase.

↳ isomorphous

↳ The stress field created by the solute atom is spherically symmetric.

↳ The spherically symmetric field ensures no shear component.

↳ Hence do not interact with screw dislocations which are pure shear dislocations.

→ will interact with edge dislocations.

↳ favourable relative arrangement lowers strain energy.

If solute < solvent {size} → attracted to compression side

If solute > solvent {size} → attracted to tension side.

☆ Interstitial atoms also create compressive stress in the lattice.

Strengthening Mechanisms

→ Strain (Work) Hardening
→ grain boundary hardening.

☆ Cold Working: → deformation at room temperature.

% cold work percentage ⇒ degree of plastic deformation.

↳ $\% CW = \frac{A_o - A_d}{A_o} \times 100$

During cold working:

↳ dislocation motion becomes difficult

↳ dislocation density increases.