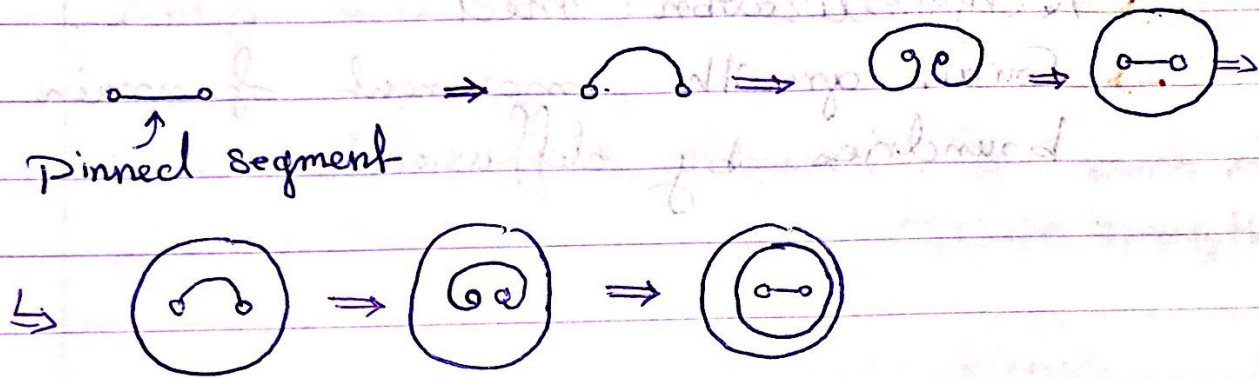


→ Chapter 7: Strain hardening & Annealing
Cold working ↑
Hot working ↑

Frank-Read source :-



Each time a new loop is forming

* Cold Working :-

Rolling

Forging

Extrusion

& stamping

Wire drawing

• Annealing (Hot working)

Stages :-

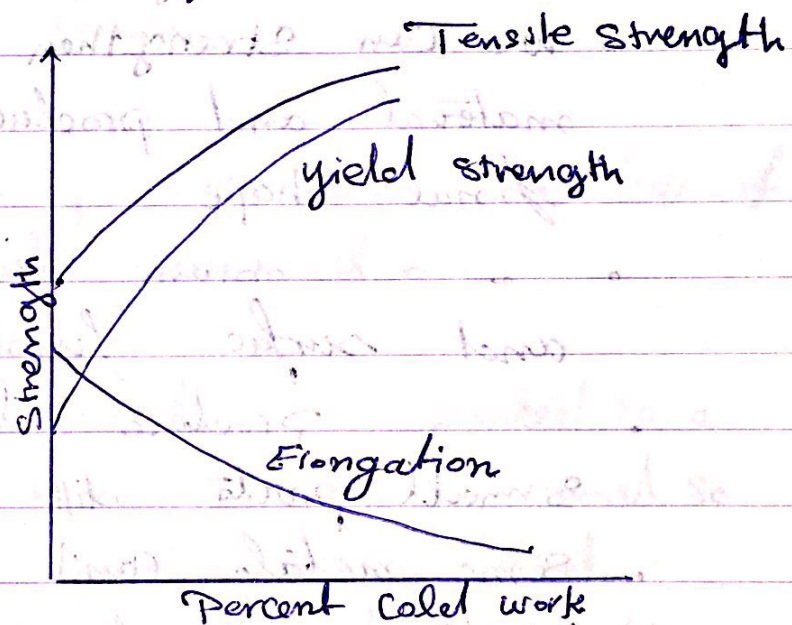
- Recovery : low-Temp annealing heat treatment
- Recrystallization : med - \approx \approx \approx
- Grain growth : movement of grain boundaries by diffusion



The effect of cold work on the mechanical properties of copper

• As the cold work \uparrow , the yield and tensile strength \uparrow and Ductility \downarrow

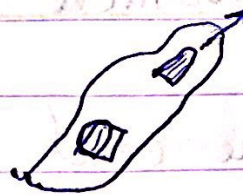
• The metal breaks if more cold work is attempted



Slide 20: During plastic deformation

Using cold or hot working, a microstructure of grains that are elongated in the direction of the applied stress is often produced

If the Rolling direction is not right
a crack will form.

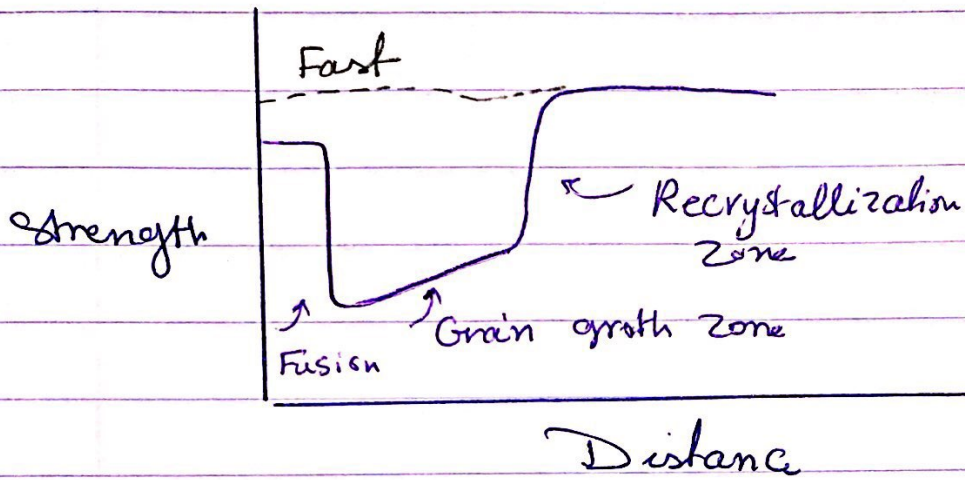


Rolling Direction

Characteristics of Cold Working :-

- we can strengthen the metallic material and produced the desired final shape
- ~ ~ obtain dimensional tolerances and surface finishes
- ~ ~ produce large number of small parts still cheaply
- Some metals can't handle cold working without breaking (after a certain point)
- cold working does not affect conductivity when strengthening the conductor

Difference Between Fast and Slow Cool



• The slow cool process causes the loss of strength of the material

• in welding metals are heated to a temp higher than critical temp and so mechanical properties are reduced catastrophically by the heat of the welding process.

→ Characteristics of Hot Working

- 1- lack of strengthening
- 2- Elimination of imperfections
- 3- Anisotropic Behavior
- 4- surface finish and Dimensional Accuracy