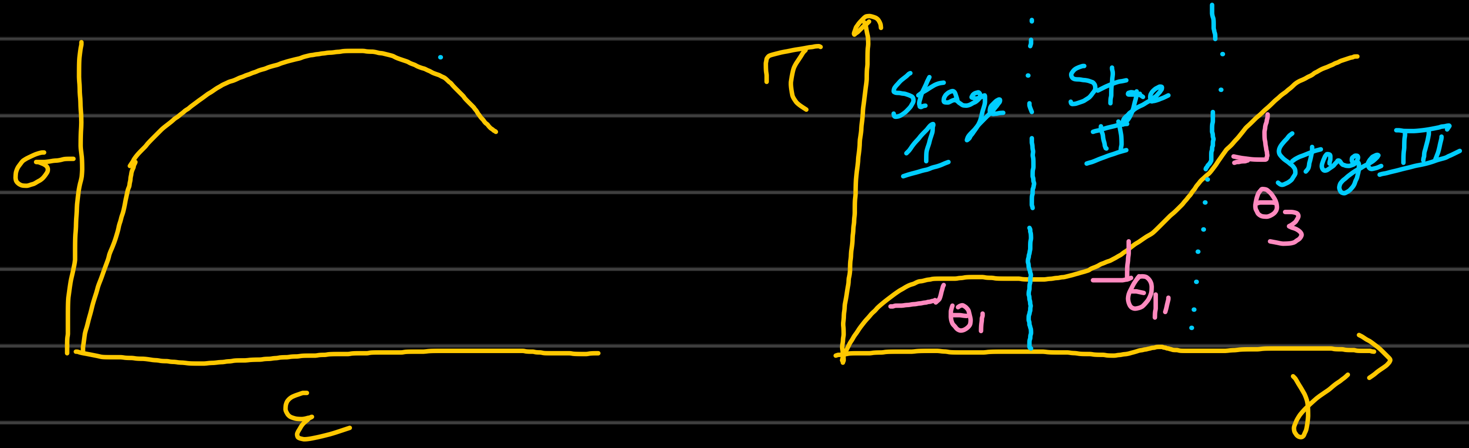
Strain Hardening



Stage I : easy glide → low hardening rate

Stage II : high constant hardening rate

Stage III : decreasing hardening rate.

→ Soft orientation : easy glide

Hard orientation : difficult glide.

* Easy glide depends on orientation of dislocations on slip planes.

Stage I :

→ τ is small : no work hardening

→ After yielding, the shear stress for plastic deformation is essentially constant.

→ Primary slip system operates:

→ Dislocations do not interactions much.

→ (easy glide)

Stage II : → Shear stress begins to increase in linear fashion.

→ slip initiated on multiple slip systems.

→ extensive work hardening $\{\theta \simeq G/300\}$

→ work hardening due to interaction b/w dislocation moving on intersecting slip planes.

Stage III: → decreasing rate of work hardening.

Cross-slip: dynamic recovery process.

↳ decrease due to increase in degree of cross-slip resulting in parabolic shape to the curve.

→ entangled dislocations find a new slip plane to get out of mess & undergo easy glide.

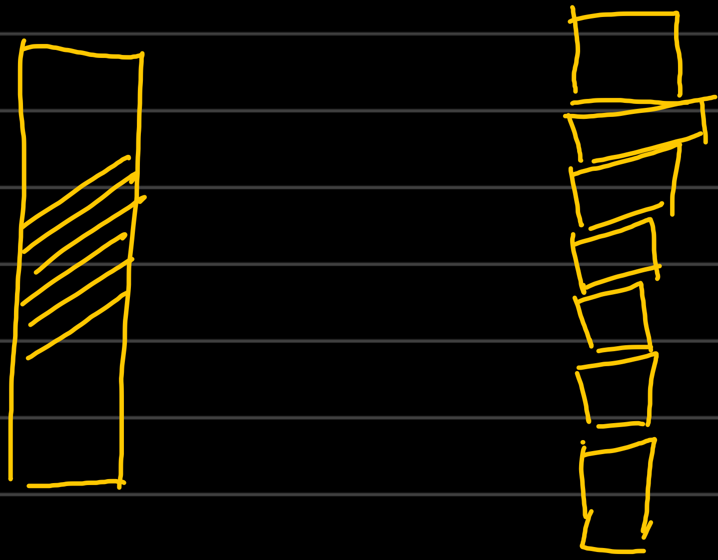
→ happens at high shear stresses (τ)

Effect of Temperature:

↳ Increasing T results in decrease in the extent of Stage I and Stage II

Stacking Fault Energy:

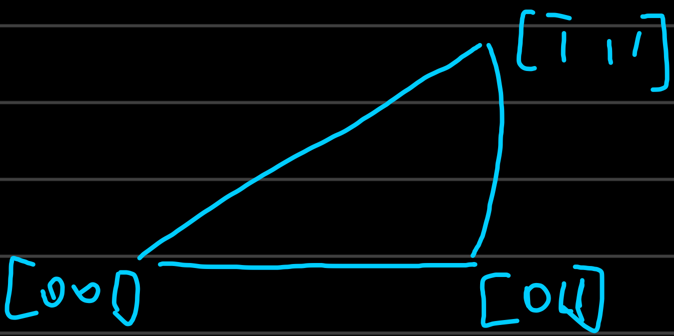
Single Crystal Yielding:



→ slip planes rotate wrt each other.

→ end pts are fixed.

→ [001] → Stereographic Projection:



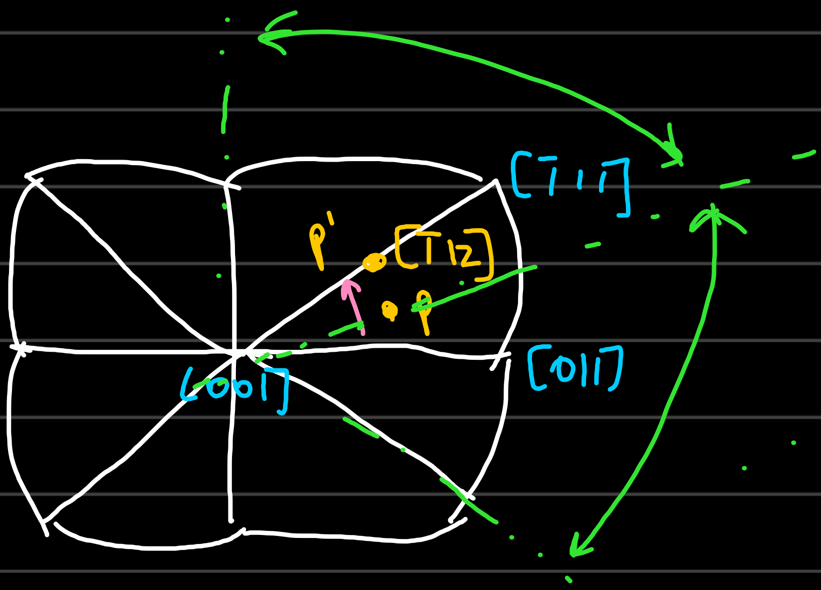
→ Tensile deformation in FCC Crystal:

↳ Duplex slip operative on 001/$\bar{1}$11 boundary.

→ Primary slip system: (111)[$\bar{1}0\bar{1}$]

→ Conjugate slip systems: ($\bar{1}\bar{1}1$)[011]

→ tensile axis rotates to $\bar{1}12$ direction under two operating slip systems and stays there until failure.



Deformation in Polycrystal:

→ deformation on only one slip system is not possible because various grains have to be compatible.

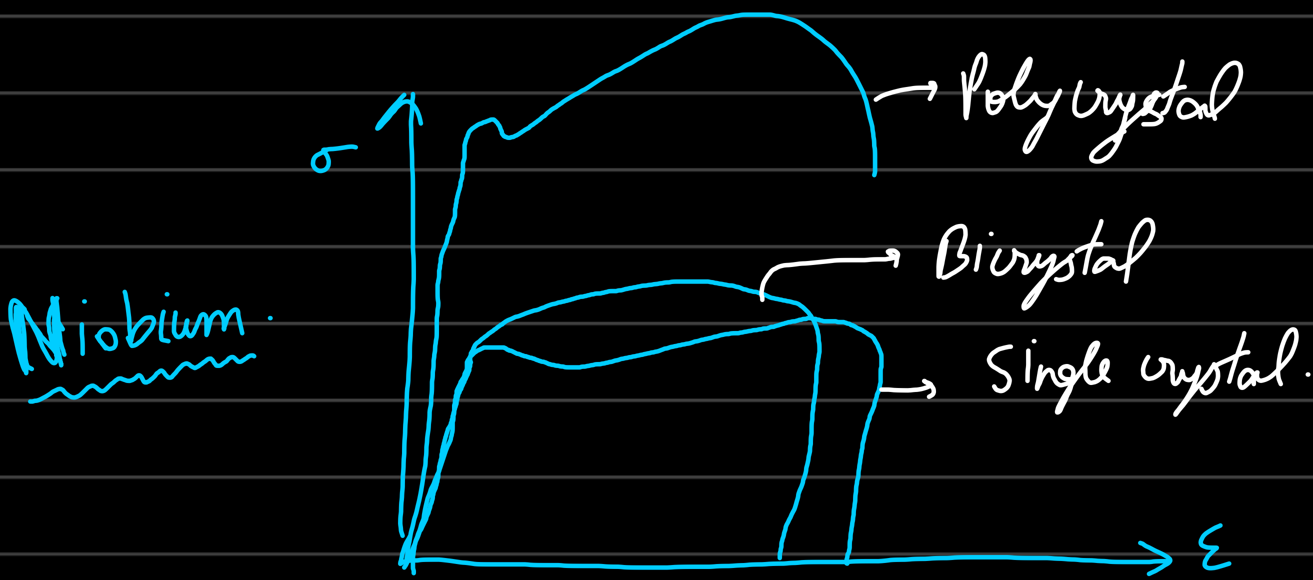
→ inherently inhomogenous (varies from grain to grain).

→ Dislocation movement is hindered because it is restricted to one grain.

$$\tau_{CRSS} = M \sigma_y$$

M ⇒ Schmid Factor {Single crystal}

⇒ Taylor Factor {Poly crystal} $M = \frac{1}{3}$



Investment Casting: Single crystal

directional solidification: bicrystal.