

Mechanical behavior of materials

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Lecture-46

Cottrell Atmosphere and Yield Point Phenomenon



Mechanical Behavior of Materials (Hindi)

Cottrell Atmosphere and Yield Point Phenomenon

Namaskar phir se swagat karta hoon aapka is course mein mechanical behavior of material jo ki hum hindi mein padhenge last part tak humne dekha tha ki solid solution strengthening kya hoti hai aur usmein humne dekha tha ki elastic interaction kya hote hain ya direction energies kya hoti hai is baare mein is course mein hum aur is part mein hum dekhenge ki Cottrell atmosphere kya hota hai aur usse yield point phenomena hum kaise explain kar sakte hain to hum yield point phenomena hum dekhte hain mild steel mein abhi mild steel kya hai mild steel jab hum baat karenge to yeh jo yield point phenomena milta hai jab mild steel well annealed ho well annealed yaani jahan pe meri dislocation density kuch is order pe ho 10^7 Per square aur jab hum mild steel ki baat karenin to interstitial solute jo hai yahan par carbon ya nitrogen wo less than hone chahiye 0.25 weight percent se abhi yeh ho gaya mera mild steel abhi jab carbon aur nitrogen ki main baat karunga to yeh jo solute atoms hai yeh mere oversize interstitial solute atoms hai ye oversize hai aur humne dekha tha ki jab atoms solute atom oversize hai to wo dislocation ke saath kahan interact

karte hain to agar mere paas kuch edge dislocation is tarah se hai to humne dekha tha ki wo slip plane ke niche jaate hain ya position occupy karte hain jahan pe tensile stress field ho to is case mein edge dislocation ke case mein mere paas tensile stress field niche thi to yahan par solute atoms prefer karenge agar wo oversize hai agar wo undersize rehte to upar wale part mein prefer karte abhi ye oversize hai to hum yahan pe check karenge ki ye oversize interstitial atom hai aur yeh occupy kahan karte hai ye occupy karte hai octahedral voids pe agar ye oversize hai to aapko compare karna padega carbon radius aur octahedral void radius se tab aapko pata chalega ki ye oversize hai abhi humne jaana ki ye oversize interstitial solute atom hai to iska dislocation motion par ya strength mein kya asar hota hai yeh hum dekhenge agar aapko yeh doubt hai ki carbon aur nitrogen oversize kis tarah se to aapko calculate karna hoga humne dekha tha ki carbon aur nitrogen jaate hain interstitial voids par aur kaun se interstitial pe voids par jaate hain woh jaate hain octahedral octahedral par jaate hain agar wo octahedral par jaate to aap iska octahedral void ka radius calculate karen aur radius ka carbon aur radius of nitrogen iske saath uski tulna karen hai oversize hoga to humein pata hai ki void ke jo radius hai usse hamara carbon aur nitrogen ka radius bada hona chahiye iske wajah se abhi dekhte hain ye oversize hai to humne dekha tha ki slip plane ke niche jayenge.

To maan lete hain mera crystal hai kuch is tarah se aur hum maan lete ki ek dislocation hai edge dislocation is tarah se maine mark kiya aur yeh ho gaya mera extra half plane aur yeh specific slip plane ki baat kar raha hoon main yahan pe aur ek dislocation ki baat kar raha hoon abhi hum dekhenge kuch yahan pe carbon atoms hai jo ki dissolved hai mere matrix mein ya solvent mein jo ki mera iron hai alpha iron yahan pe main baat kar raha hoon to ye in defects ko ye point defects hai yaani jo carbon ya nitrogen hai inko main point defects pe keh sakta hoon yahan pe in defects ko main kahunga Field of Point Defects abhi kya hoga is dislocation ki jo stress field hai wo ye jo solute atoms hai inke distortion ke stress field ke saath interact karegi humne dekha tha ki ek interaction energy wo hogi aur oversize atom ke liye yeh jo solute atoms hai wo slip plane ke niche jayenge aur woh kuch is tarah se jayenge attract hoke aur yahan par main dekh paa raha hoon ki slip plane ke niche mujhe yeh solute atoms is tarah se arrange ho jayenge aur isko hum kehte hain Cottrell Atmosphere yeh jo arrangement yahan par humne dekhi yeh hai meri Cottrell atmosphere ya isko hum Cottrell-Bilby Cloud bhi kehte hain kyunki yahan par yeh jo solute atoms hai yeh inka concentration badh jayega ya yahan par yeh jo solute atoms hai.

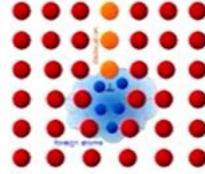
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Cottrell atmosphere: Yield Point Phenomenon

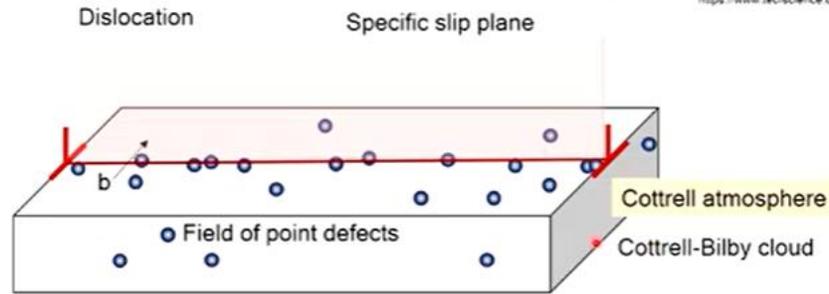
Mild steel Well annealed $\rho = 10^7 \text{ cm}^{-2}$

Interstitial solute C or N ($\leq 0.25 \text{ wt. \%}$)

C and N: Oversized interstitial solute



C, N, interstitial
octahedral
voids
 r_c r_N



Mere dislocation ko dislocation ke saath interact karke iski energy thodi kam karenge isko hum kehte hain Cottrell atmosphere aur Cottrell-Bilby cloud abhi Cottrell atmosphere to humein samajh mein aaya abhi iska asar kya hoga yield point par yeh hum dekhenge to uske liye hum ek case consider karte hain jab yield point main baat karunga tab main stress aur strain ki baat kar raha hoon to yahan par main stress aur strain plot karne wala hoon aur yeh hum dekh rahe hain mild steel ke liye aur jab main stress strain plot karta hoon to main deformation constant strain rate pe karta hoon mujhe yield point jab nikaalna hai tab main constant strain rate pe deformation karta hoon aur abhi maan lete hain kuch ek slip plane hai mere paas is tarah se aur wahan pe ek dislocation hai aur mere paas kuch solute atoms hai aur yahan pe kuch Cottrell atmosphere hai yeh dislocation ke around yaani is dislocation ke jo slip plane ke niche hai yeh saare carbon atoms yahan pe assembled hai ya arranged hai to abhi iske wajah se kya hoga iske wajah se hoga ki is dislocation ki energy kam ho gayi hogi aur kam hogi iske wajah se kya hoga jab main stress apply karunga tab stress apply karunga to is dislocation ko move karne ke liye mujhe jyada stress ki zarurat lagegi aur yeh jo stress hai dislocation ko move karne ke liye yaani is dislocation ko yahan se in Cottrell atmosphere se remove karne ke liye yeh bada hai as compared to is dislocation ko is glide plane par move karne ke liye ye aap isko samajhiye yahan pe τ_{glide} Yaani jo shear stress mujhe lagega glide karne ke liye yeh kam hai mujhe is dislocation ko unlock karne ke liye kyunki yahan pe ye dislocation to locked hai kyunki yeh mera Cottrell atmosphere yahan pe taiyaar ho gaya to pehle is dislocation ko move jab karna hai is slip plane pe to mujhe jyada shear stress ya stress ki zarurat rahegi to jab main deformation karunga to pehle to elastic deformation hoga uske baad ek point yahan par main reach karunga stress ka jo is dislocation ke unlock stress ke barabar hoga yeh point yahan par to yeh point yahan par reach karunga aur jaise yeh point yahan par reach karunga to yeh dislocation yaani itna stress maine apply kiya ki is Cottrell atmosphere se mera dislocation free ho jayega aur free hoke phir move karega abhi aap dekhenge ki dislocation jaise hi free hota hai to yeh jo stress hai is dislocation ko glide karne ke liye slip plane pe move karne ke liye slip plane pe ye higher nahi hai yaani hum already stress par pahunch chuke to ye dislocation aasaani se move hoga to hum dekhenge ki yeh dislocation ki velocity bahut high rahegi

aur jaise yeh dislocation free ho jayenge move hone ke liye is Cottrell atmosphere se hum dekhenge ki dislocation density bhi badhti hai to hum dekhenge ki mere dislocation ko move karne ke liye kuch higher stress ki zarurat nahi hai to yeh jo dislocation hai isko higher stress ki zarurat nahi hogi to lower stress par main aa jaunga aur uske baad ye dislocation move hoga kuch is tarah se deformation meri badhegi is tarah se to yeh jo point hai do point yahan par hum dekhenge yeh jo ab point hai isko main kehta hoon Upper Yield Point kyunki yahan par mera dislocation free ho gaya tha Cottrell atmosphere se aur jaise hi free ho jaata hai mujhe higher stress ki zarurat nahi hoti hai aur main is is stress value par bhi mere dislocation ko move kar sakta hoon yaani mera deformation continue kar sakta hoon isko main kehta hoon Lower Yield Point yeh ho gaye mere upper yield point aur lower yield point stress strain curve ki jab main baat kar raha hoon aur is drop ko stress drop ko main kehta hoon Yield Drop yaani yahan pe agar yield strength yahan pe main dekhunga yahan pe higher stress hai yahan pe lower stress hai ye jo drop hai isko main kehta hoon yield drop.

To abhi hum jaante hain ki humne bataya tha ki jab stress strain curve ki main baat karunga to main yeh evaluate karunga constant strain rate pe to main strain rate jab likhunga to main mere paas ye equation tha yeh humne derive kiya tha yahan par mobile dislocation density hai Burgers vector hai aur velocity of average velocity of dislocation hai yeh yeh humne dekha tha Orowan equation to jab main is is stress par jahan jab pahunch jaunga to aap dekh paa rahe honge aur jaise hi yeh dislocation unlock ho gaye yahan par wo suddenly move karenge tezi se move karenge to unki average velocity hai wo suddenly badhegi yaani meri v badh rahi hai aur maine bola tha ki jaise hi dislocation move karna chalu karenge wo dislocation density bhi badhayenge to mera ρ_m Bhi badh raha hai aur v bhi badh raha hai to upper yield point pe mujhe kuch yeh condition milegi yeh jo product hai ρ_m Aur \bar{v} Yeh badhega par humne dekha tha ki ye jo hai strain rate ye constant hona chahiye agar yeh constant hai to kya isko constant karne ke liye kya kar sakte hain kyunki ye b to mera constant hai to iske liye ek hi cheez ho sakti hai ki agar mera $\dot{\gamma}$ Constant rehna chahiye ya strain rate constant rehna chahiye to mera stress jab decrease hoga humne dekha tha jaise stress mera decrease hoga waise hi ρ_m Aur v ki value decrease ho sakti hai strain rate strain yahan se decrease hoga aur main lower yield point pahunch jaunga to strength rate constant rakhne ke liye kyunki mera ρ_m Aur v bada hua hai to stress agar kam ho jaye to main is strain rate ko constant rakh paunga aur is strain rate ko constant rakhne ke liye main yield point tak lower yield point tak aa jaunga aur isi ko hum kehte yield drop to yield drop hamare strain rate constant rakhne ke liye hota hai abhi yeh jo deformation hai yeh humne samajh liya upper yield point aur lower yield point abhi yeh jo deformation hai yeh ek plateau region hai yaani yahan pe dekhenge ki jo stress hai woh more or less constant hai wo change nahi ho raha hai yahan pe to yeh jo constant stress hai isko hum kehte hain Yield Point Elongation ya Luders strain abhi yeh kiske wajah se hota hai yeh region jo hai wo mera Inhomogeneous Deformation ke wajah se hota hai abhi in homogeneous deformation ko kya kaise ho raha hai hum abhi hum dekhenge ki yahan pe kuch deformation is tarah se ho raha hai to yeh mera tensile sample hai aur isko main stress kar raha hoon to yahan pe kuch localized yahan par deformation chalu ho gayi yahan pe jo ek maine mark kiya hai aur yeh jo deformation hai ek yeh jo do hai teen hai chaar aur paanch yeh saari localized formation aap dekhenge ki ye jo bands yahan pe ban rahe hain sample ke upar isko hum kehte hain Luders Band to yeh Luders band yahan par banenge aur yeh propagate hote hain aap dekh paa rahe honge ki ek is tarah se propagate ho raha hai yahan par main bata raha hoon is tarah propagate ho raha hai gauge length mein to gauge length mein is tarah se propagate hua hai to ek region jo hai yahan par badh gaya yahan par is tarah se to aur yahan par bhi aap dekhenge ki yeh jo localized deformation

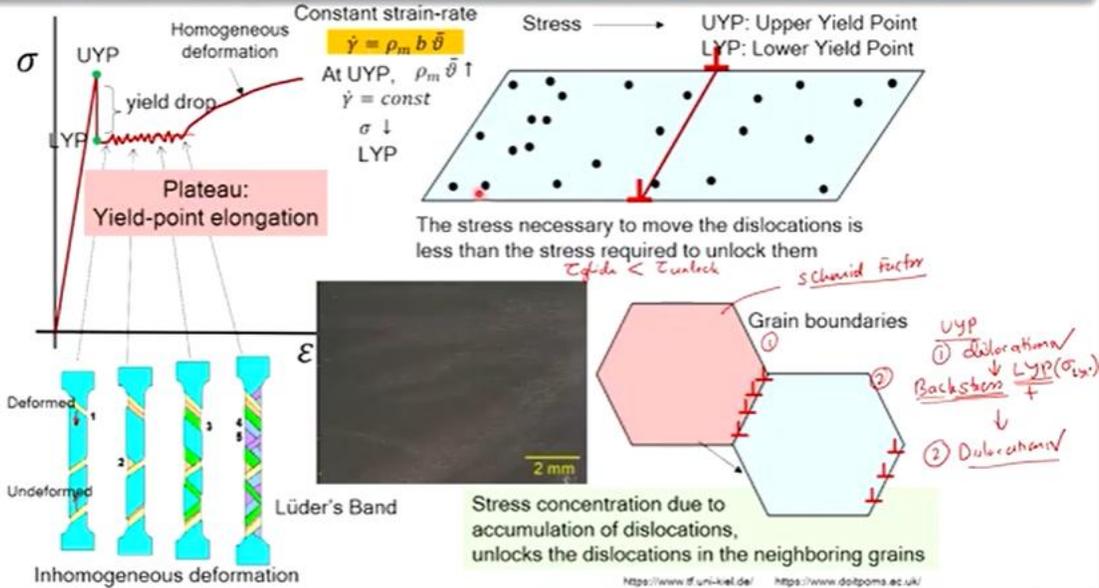
hai wo badh rahi hai aur jab yeh pura sample ka gauge length complete ho jayega mere localized deformation ke dwara tab mujhe jaake ek homogeneous deformation is tarah se milegi.

Abhi hum dekhte ki ye lower yield point par ye yield point elongation ke humne to schematic dwara dikha diya hai ki is tarah se ek Luders band banenge jo ki localized formation hai to inko bhi hum inhomogeneous deformation kehte hain kyunki yeh locally propagate ho rahe hai ab yeh kyun ho rahe hai yeh samjhenge yeh mera deformed region hai jahan par maine bands likha hai aur jo blue color hai woh mera undeformed region hai to mera jo deformed region hai wo badhega kuch is tarah se aur yahan par aap dekh paa rahe honge ki jab is stage par aa jaunga main yahan par to yeh jo pura undeformed region hai woh cover ho jayega deformed region se aur uske baad mujhe homogeneous deformation milegi abhi jaante ki Luders bands kaise taiyaar hote hain uske liye humein samajhna padega ki hum polycrystalline material ki baat kar rahe yahan par jab main polycrystalline material ki baat kar raha hoon jab maine isko tensile deformation kiya to sabse pehle kis grain par deformation chalu hoga to hum humne dekha tha ki yeh deformation chalu hoga jahan par Schmid factor jyada hai mere tensile axis ke dwara to yahan par main dekh paa raha hoon ki agar main maan leta hoon is grain par agar Schmid factor jyada hai aur is grain par kuch dislocation hai is tarah se in dono grains mein kuch dislocations hai to kya hoga sabse pehle yeh grain deform karna chalu hoga aur yeh jo grain hoga yeh majorly align kis tarah se hoga iska orientation aise hoga ki yahan par sabse jyada maximum shear stress lagna chahiye jo ki 45 degree ke around hota hai majorly to isliye jo bands hai aap dekh paa rahe honge ki yeh mostly 45 degree se chalu hote hain to maan lete hain yahan par mujhe sabse jyada Schmid factor hai to yeh grain sabse pehle plastically deform hona chalu hoga to yahan par sabse pehle main is value tak aayunga upper yield point tak tab jaake ye kyunki yahan par dislocation jo hai woh mere atmosphere ke dwara pinned hai yaani bandhe hue hain to in dislocations ko mujhe free karna hoga yeh jab free honge tab jaake mera deformation aage badhega tab jab main upper yield point tak pahunchta hoon tab aap dekhenge ki yeh dislocation tezi se move hoke is grain boundary tak aake ruk jayenge kuch is tarah se to yeh dislocation yahan par ruk jayenge tab aap dekhenge is dislocation ki wajah se ek stress concentration taiyaar hoga is grain boundary ke upar ya main keh sakta hoon ek stress taiyaar hoga jo assist karega mere second grain jo hai neighboring jo grain hai iske deformation ke liye to yeh jo deformation hua mere localized grain ka ya localized region ka isko isko hi main kehta hoon inhomogeneous deformation to main kuch is tarah se baat kar sakta hoon yahan par maine dekha yahan pe ek stress taiyaar hua aur yeh stress assist karega is dislocation in grain ke dislocations ko move karne ke liye aur woh bhi aake yahan pe is grain ki grain boundary pe ruk jayenge to yahan pe main dekh paa raha hoon jaise main upper yield point pe pahunch jaau to yeh dislocation move ho jayenge grain one ke is grain ko main naam deta hoon one aur two grain one ke dislocations move honge to yeh grain dislocations jab move honge yeh create karenge ek stress ko aur yeh jo stress yahan par jaise ye move ho jayenge main lower yield point par aa jaunga yaani lower yield point ke stress ke corresponding main aa jaunga aur yeh jo stress hai stress concentration hai yeh lower yield point ke stress ko add ho jayega aur yeh dono mil ke ke do grain ke dusre number ke grain ke dislocations ko move karenge to isko hum likh lete hain to main likh sakta hoon ki ek stress concentration taiyaar hoga jab yeh dislocation one move honge ek grain mein aur ye accumulate honge mere grain boundary ke upar aur yeh ek stress concentration taiyaar karenge aur wo jo stress concentration hai wo add ho jayega mere lower yield point ke stress ki corresponding aur wo dono mil ke ek bada stress taiyaar karenge aur wo stress jaake wahan se yeh dusre neighboring jo grain hai us grain ke dislocation ko unlock karenge aur woh bhi move honge yaani is grain two ka bhi deformation chalu hoga isliye hum dekhte hain ki jaise hi lower yield point aa gaya mera jo deformation hai wo progress hoga kuch is tarah se yaani main dekh paa raha

hoon yahan ke pe agar mera deformation chalu ho gaya woh progress karega neighboring regions pe aur jo inhomogeneous deformation hai wo progress karega mere gauge length ke upar to aur mujhe uske liye koi stress atirikt stress ki koi aavashyakta nahi hai to isliye main yahan pe dekhunga ki stress more or less constant hai to abhi humne yeh dekha hai yield point phenomena aur uske baad humne yield point elongation bhi dekha hai to abhi hum ek video dekhte hain jisse hum samajh payenge experimentally ki kis tarah se yeh Luders band taiyaar hota hai to yeh credit jaata hai Meyer aur Brommss ko aur yahan par hum dekhenge deformation ke dauran kis tarah se sample mein Luders band taiyaar hote hain to mera tensile sample hai abhi aap dekh paa rahe honge ki isko main stretch karta hoon to kuch Luders bands is tarah se taiyaar honge gauge length ke upar yahan par dekh rahe honge yahan par kuch Luders band taiyaar ho rahe hai aur yahan par kuch Luders band taiyaar honge aur aap dekh rahe honge ki iska jo angle hai around 45 degree hai kyunki yahan pe maximum shear stress milega tensile agar main tensile force apply kar raha hoon aur aap dekh paa rahe honge ki ye Luders band is tarah se propagate ho raha hai yaani ye Luders band is tarah se aa raha hai aur ye Luders band niche se upar ki taraf aa raha hai aur yeh propagate hoke kuch is tarah se move karenge aur jab yeh complete gauge length occupy ho jayega is Luders band se tab jaake mera inhomogeneous deformation khatam hoga phir mera ye jo sample hai wo homogeneously deformation chalu hoga abhi aap dekhenge kuch high magnification mein yahan par kuch taiyaar ho rahe hain aur aap dekh rahe honge ki ye jo Luders bands hai is tarah se propagate ho rahe hai aur ye is tarah se propagate ho rahe hai kyunki mere kuch grain yahan par deform honge aur wo assist karenge mere neighboring grains ko deform hone ke liye to aap dekh paa rahe honge ki Luders bands kuch is tarah se propagate honge aur ek dusre ke deformation ko assist karenge yeh hoga mera yield point elongation ke dauran aur abhi aap dekhnge ki yeh saare grains jo hai yaani inhomogeneous reformation is tarah se progress karega to abhi humne dekha ki yeh jo Luders band hai yeh 45 degree par hote aur yeh jab Luders bands khatam ho jayenge yaani inhomogeneous reformation khatam ho jayega tab mujhe jaake ek homogeneous deformation milega kuch is tarah se kuch is tarah se mujhe homogeneous deformation milega to yeh ho gaya mera yield point phenomena yeh yield point phenomena kyun milta hai kyunki mere paas ek Cottrell atmosphere hai aur Cottrell atmosphere se mere dislocation ko move karne ke liye mujhe jyada stress ki zarurat hoti hai as compared to mere dislocation ko glide karne mein to yahi reason hai mere yield point aur upper yield point aur lower yield point ka.



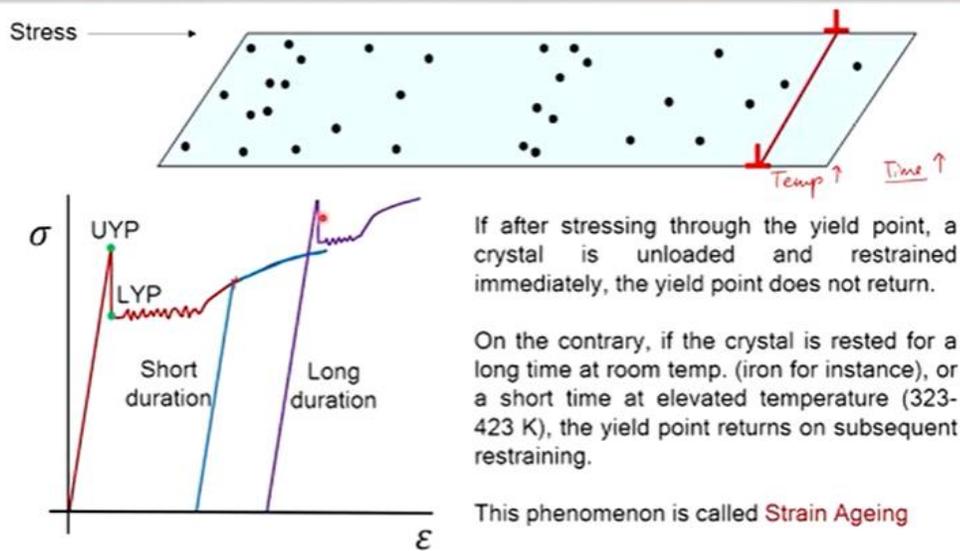
Yield Point Phenomenon & Lüder's Band



Abhi hum kuch aur ek concept dekhte hain Strain Aging mein to strain aging kya hoti hai jaante hain agar mere paas stress strain relation hai aur mere paas kuch dislocation is tarah se jo ki yahan par Cottrell atmosphere maine yahan par dikhaya is dislocation pe aur main stress apply karta hoon to yeh dislocation move hoga aur mujhe upper yield point aur lower yield point aur is tarah se kuch homogeneous deformation milega jab main strain aging ki baat karunga tab main agar maan lijiye maine kuch is tarah se deform kiya mera material aur main kuch samay ke liye yahan par deformation rok diya ya unload kar diya mere sample ko aur maine sirf short duration ke liye yaani kam samay ke liye wait kiya to yeh dislocation kuch is tarah se move ho jayega abhi hum dekhenge ki yahan pe koi Cottrell atmosphere nahi hai jab main short duration ki baat kar raha hoon to short duration mein yeh carbon atoms yahan par diffuse hoke is dislocation ke around Cottrell atmosphere nahi taiyaar kar payenge kyunki samay bahut kam hai to hum dekhenge ki ye upper yield point aur lower yield point yahan pe jab main unload kar diya maan lete hain maine kuch yahan par kuch unload kar diya is point pe aur yahan se unload karke phir se load kiya kam samay mein yaani samay maine diya nahi to mujhe kuch deformation milega jab main phir se stress apply karunga to jab deformation milega to aap dekhenge ki mere paas upper yield point aur lower yield point nahi milega aur ye jo deformation hai kuch yahan se hi shuruat hogi kuch is tarah se abhi main kuch long samay ke liye yaani jyada samay ke liye rukta hoon to ya main kuch temperature apply karunga to aap dekh paa rahenge ya kuch yaani temperature ke saath agar kuch temperature maine apply kiya ya time maine badha diya maine unload kar diya yahan pe aur time agar main jyada samay ke liye badhaunga to aap dekh paa rahe honge ki is carbon atoms ko samay milega ki Cottrell atmosphere is dislocation ke around phir se taiyaar kare kuch is tarah se yeh Cottrell atmosphere phir se taiyaar karega ab jaake mujhe agar maine phir se unload kiya hai aur phir se lambe samay ke baad phir se load karunga tab mujhe ye dislocation mein phir se upper yield point aur lower yield point aur yeh phenomena phir se milega yeh jo re-occurring hai phenomena ka isko hi hum kehte hain Strain Aging to yahan pe hum dekhenge jab maine unload kiya tha material ko aur immediately load kiya to yield point humein wapas nahi mila tha par jab hum material ko temperature ke saath ya time ke saath lambe samay ke liye chhod denge aur hum dekhenge ki phir se humein yield point wapas milega isi phenomena ko hum kehte hain strain aging.



Strain Ageing

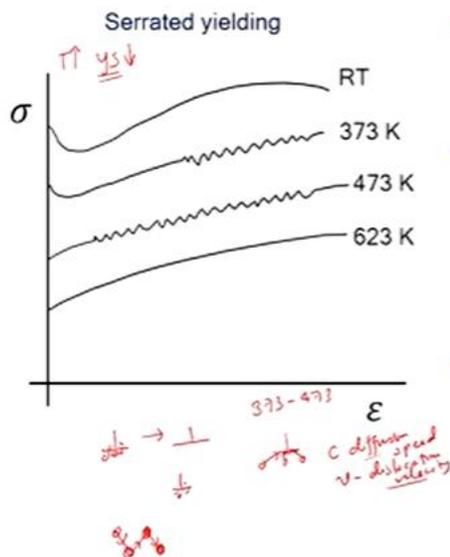


To yeh hogi meri strain aging material mein abhi hum aur ek effect dekhte hain usko hum kehte hain Portevin-Le Chatelier Effect yeh effect mein kya hota hai hum dekhenge agar main stress strain plot kar raha hoon aur main room temperature mein mujhe stress strain mil raha hai is case mein hum dekhenge ki main higher temperatures mein ja raha hoon 373 Kelvin 473 Kelvin aur aur high temperatures pe jaunga 623 Kelvin to kuch intermediate temperatures pe yaani 373 aur 473 Kelvin pe mujhe kuch serrated yielding mil rahi hai yeh jo phenomena hai yahan pe stress kam is tarah se move ho raha hai ya ghat raha hai badh raha hai isko hum kehte hain Serrated Yielding yeh milta hai humein kuch temperature ke dauran ye room temperatures pe nahi mil raha hai aur high temperatures pe nahi mil raha hai to abhi aap pehla to effect yeh dekh sakte hain ki yahan par yield strength jo hai mere material ka jaise jaise temperature badh raha hai waise yield strength mera ghat raha hai abhi hum dekhte hain ki yeh serrated yielding ka reason kya hai to yeh milta hai humein kuch hi temperature ke dauran yeh isliye milta hai kyunki jab hum dekhenge hamare paas dislocation hai woh Cottrell atmosphere se mukt ho gaye tab woh aasaani se move ho sakte hain par agar hum kuch temperature yahan par apply kar rahe to hum dekh paa rahe honge ki agar mere paas kuch dislocation hai aur yahan par kuch Cottrell atmosphere hai kuch is tarah se aur yeh dislocation free ho gaya jab main stress apply karunga kuch temperatures par jaise yahan par 373 aur 473 maine mark kiya hai yahan par kya hoga yeh jo dislocation hai yeh jab move ho karenge aur ye carbon atoms temperature ke saath is temperature par aasaani se diffuse ho payenge to aap dekh paa rahe honge ki jo carbon atom ka diffusion velocity jo hai diffusion speed bolunga aur velocity jo hai dislocation ki dislocation ki velocity hai yeh dono match karti hai aur mujhe jab dislocation move honge to ye continuously pinned hote rahenge yaani aap dekhenge ki jaise mera dislocation yahan se mukt ho gaya phir se carbon atoms yahan pe aa gaye to phir se mujhe jab dekhunga jab Cottrell atmosphere tha to mere paas jo stress tha wo high tha phir jaise mukt ho gaya to stress kam ho gaya phir se Cottrell atmosphere bana to stress badhega phir se dislocation free honge Cottrell atmosphere se to stress drop ho jayega to kuch is tarah se mujhe stress badhega ghatega is tarah se milega to yeh jo serration hai stress strain curve pe isko hum kehte hain serrated yielding aur yeh hota hai kuch hi temperatures ke dauran.

To yahan par hum dekh sakte hain ki ek statement humne likha hai ki jo solute atoms hai yeh sufficiently mobile rehte aur moving dislocation ko yeh pakad sakte ya catch kar sakte aur unko pin kar sakte hain to yahan par mujhe dislocation ko repeatedly atmosphere se mukt karna padega aur isi repeated locking unlocking dislocations ki wajah se mujhe ek serrated yielding milti hai isi effect ko hum kehte hain Portevin-Le Chatelier Effect agar hum dekhenge room temperature pe hum dekhenge ki yeh jo solute atoms ki mobility hai bahut kam hoti hai to dislocation ko woh pin nahi kar paate aur higher temperatures pe hum dekhenge ki dislocation ki hi speed itni jyada hoti hai as compared to aapke solute atoms ki tab bhi woh pin nahi kar paate ek intermediate temperature par hi yeh solute atoms ki speed ya solute atoms ki mobility hai aur dislocation ki jo mobility hai woh match kar jaati hai aur dono ek dusre ko interact karke pin kar sakte hain to isliye humein Portevin-Le Chatelier ek effect milta hai kuch intermediate temperature pe.



Portevin-Le Chatelier effect



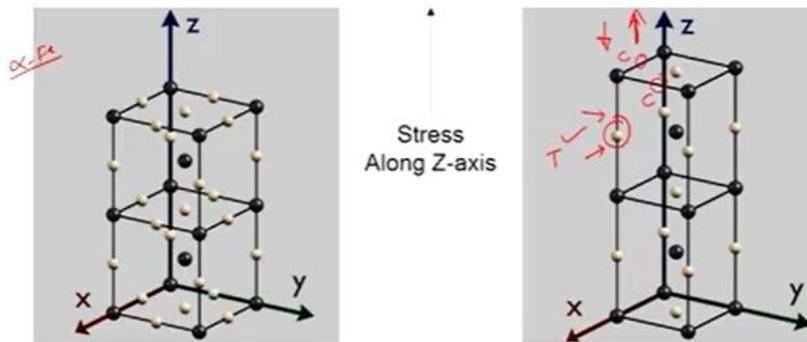
- As the temperature of deformation is increased, the sharp yield point is gradually eliminated - stress strain curves exhibit small serrations, that are not observed at low temperatures.
- These were first observed in iron containing small amounts of carbon and the effect is known as Portevin-Le Chatelier effect.
 - Observed also in non-ferrous solid solutions, e.g., brass, Al alloys.
 - Occurs both in single and polycrystalline samples.
- At these temperatures (373-573 K for iron), the solute atoms are sufficiently mobile to be able to migrate to moving dislocations and pin them. The dislocations in turn repeatedly break away from their atmospheres. This repeated locking and unlocking of dislocations results in serrated yielding.

Abhi hum aur ek effect dekhte hain Snoek Effect to yahan par maine ek BCC crystal yahan yahan pe nikala hai ya isko main aap keh sakte hain alpha iron maine yahan pe mark kiya hai aur yahan pe hum dekh sakte hain ki carbon atoms humne dekha tha ki woh octahedral voids pe jaate hain to octahedral voids mere face ke centers pe rehte hain aur edge ke centers pe to ye jo white atoms maine dikhaya ye mere carbon atoms hai yahan pe abhi agar mere paas ye is tarah se crystal hai aur is crystal ko main stretch karta hoon is z-axis ke along to aapko yahan pe milega jab elastic deformation hoga is crystals ka tab z-axis ke along elongation milega aur x aur y axis ke along contraction milega to aap dekh paa rahe honge ki yahan pe octahedral voids main yahan pe mark kar leta hoon to mujhe z-action z-direction ke along elongation milega aur is y aur x direction ke along contraction milega to aap dekh paa rahe honge ki yeh jo z dimension hai wo thodi elongate hogi to mere carbon atoms aap dekh paa rahe honge ki yahan se edge centers is edges se yeh main yahan par mark kar sakta hoon yeh jo do edges hai yeh prefer karenge rather yeh prefer karenge yahan par kuch is tarah se to yeh carbon atoms preferred karenge ki mere jo z direction ke along jo edges hai us par occupy ho to aap dekh paa rahe honge ki yeh saare carbon atoms jo maine mark kiye wo z direction ke along hai ya is face pe hai par wo is edges par nahi hai x aur y direction ko jo parallel edges hai un par nahi hai to yeh jo ordering hai mere carbon atoms ka jab main stress

apply karta hoon isko hi hum kehte hain Snoek Effect aur yeh important hai kyunki interstitial atoms yahan pe z-axis ke along move ho gaye aur jab main stress apply karunga $\langle 111 \rangle$ direction ke yeh yaani main kisi particular direction pe jab apply karta hoon tabhi yeh Snoek effect milta hai $\langle 111 \rangle$ direction ke against apply karunga to wahan par mujhe yeh jo site hai change in site nahi milegi yeh aapko ye dhundh sakte ki yahan par jab main $\langle 111 \rangle$ direction ke along apply karunga stress to yeh jo site hai x y aur z sites jo hai yahan par stress field kya hoti hai yeh aapko figure out karna hai yeh application mein aata hai jab main oscillating stresses apply karta hoon jab maanenge jab agar main oscillating stress apply kar raha hoon jab tension mein hoga to agar tension mein x z direction ke along force apply kar raha hoon to tension mein ye site prefer ki jayegi tension mein aur compress jab karunga is crystal ko is direction mein to ye sites prefer ki jayegi x aur y compressions mein to aap dekh paa rahe honge ki yeh jo carbon hai woh apni site change kar sakta hai jab main koi stress apply karta hoon crystal ko ek particular direction ke along to yahan pe aap dekh paa rahe honge ki strength meri ghategi badhegi us direction ke along jab mere carbon atoms occupy honge aur yeh humne baat ki thi ki alpha iron ke liye to aapko main exercise dena chahta hoon ki aap dekhiye ki gamma iron mein mujhe Snoek effect milta hai ki nahi milta hai to is part mein humne dekha ki Cottrell atmosphere se yield point phenomena kis tarah se aata hai aur do effects dekhe humne strain aging dekha hai Portevin-Le Chatelier effect dekha hai aur Snoek effect dekha hai yeh bhi saare mere dislocations ya stress field ka interaction solute atoms ke saath aur isse strength kis tarah se ghat-ti hai badhti hai yeh humne jaana is part mein abhi humne solid solution strengthening ke baare mein acche se padha hai.



Snoek Effect



The interstitial atoms will move to sites along Z-axis

A stress applied in the $[111]$ direction will not result in a change of site

The application of the oscillatory stress?

Would you expect to observe the Snoek effect in γ -Fe?

<https://commons.wikimedia.org/wiki/File:Snoek-effect.jpg>

Abhi next part se hum aur kuch kya strengthening mechanism hoti hai material mein yeh jaanenge abhi ke liye yahi rukta hoon dhanyavad