

03

MATERIAIS E PROCESSOS MECÂNICOS DE FABRICAÇÃO

Engenharia de Controle e Automação
Prof. Luis Fernando Maffei Martins

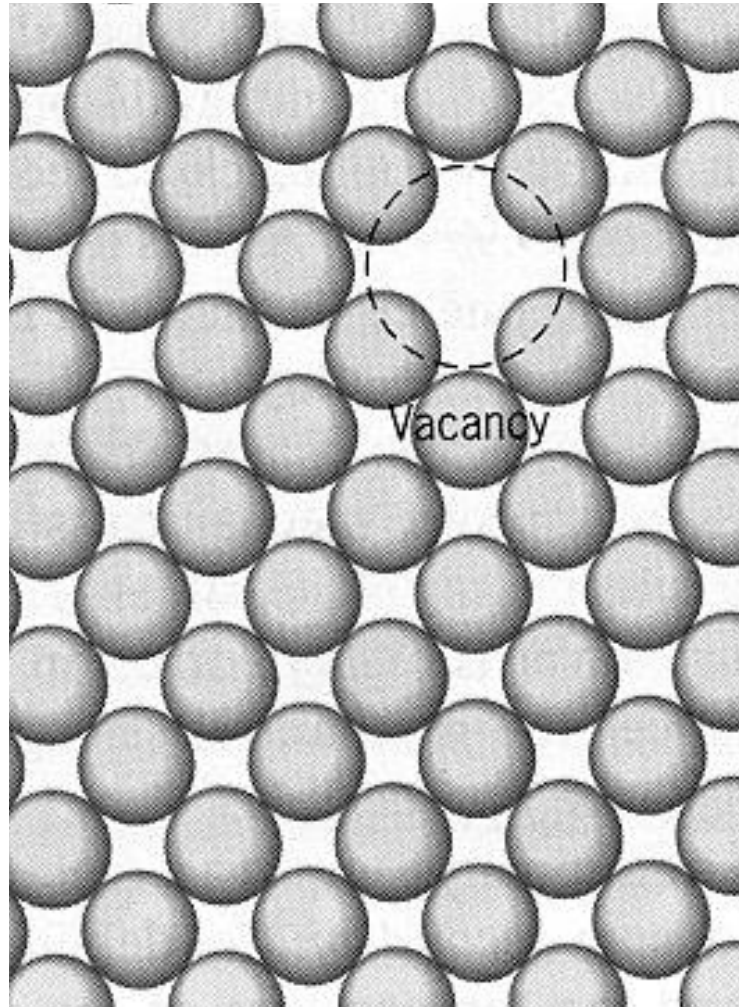
Estrutura dos sólidos cristalinos

As estrutura dos sólidos cristalinos não são perfeitos pois apresentam defeitos cristalinos. O estudo e o entendimento dos defeitos é essencial para a compreensão das propriedades dos materiais.

Os defeitos cristalinos podem ser classificados em função de sua geometria, dividindo-se em:

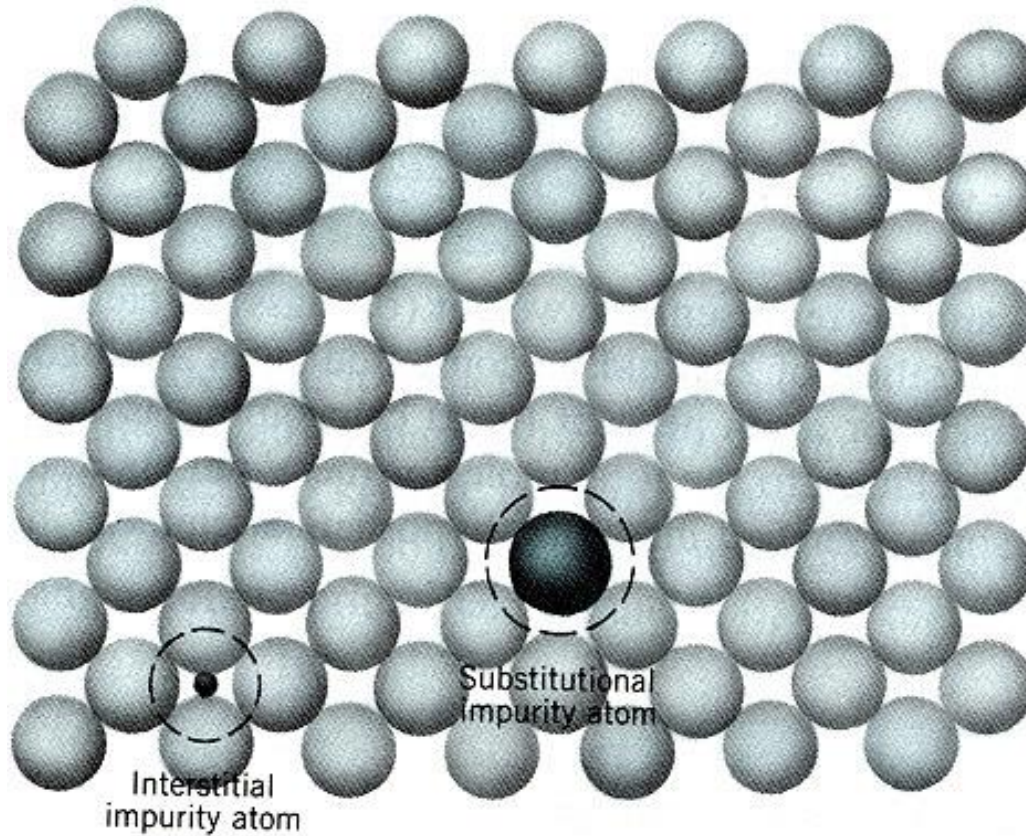
- defeitos puntiformes
- defeitos de linha (unidimensionais)
- defeitos de superfície (bidimensionais)
- defeitos de volume (tridimensionais)

Defeitos puntiformes



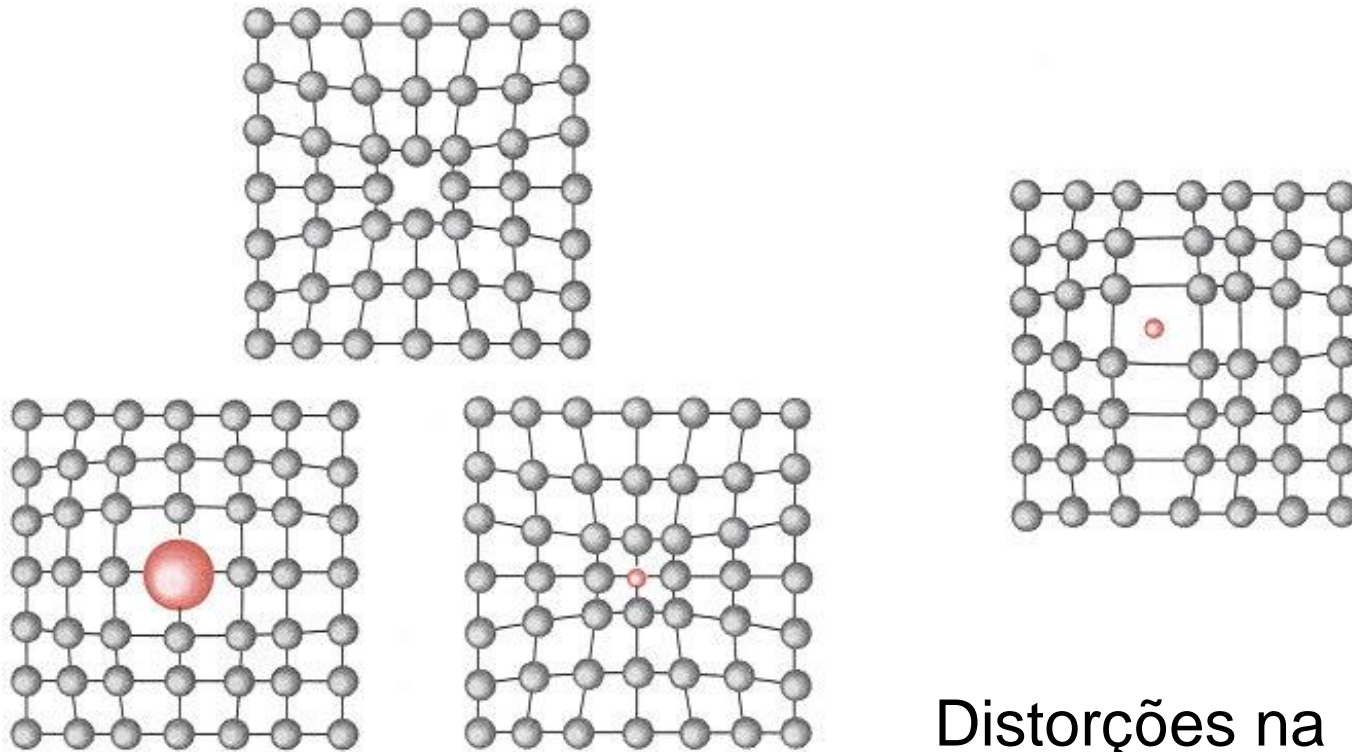
lacunas

Defeitos puntiformes



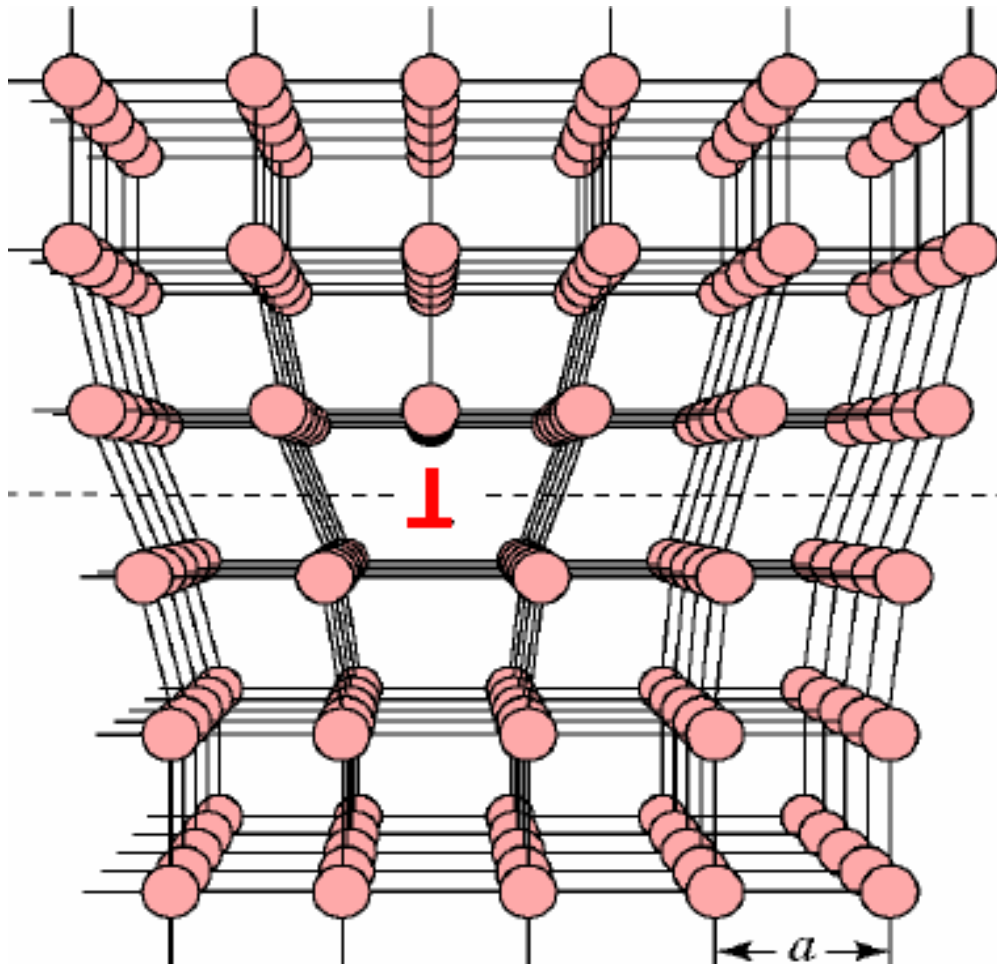
Átomos
intersticiais e
átomos
substitucionais

Defeitos puntiformes



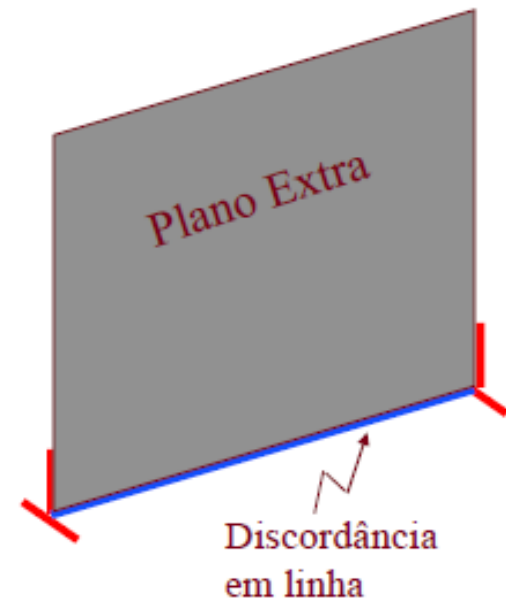
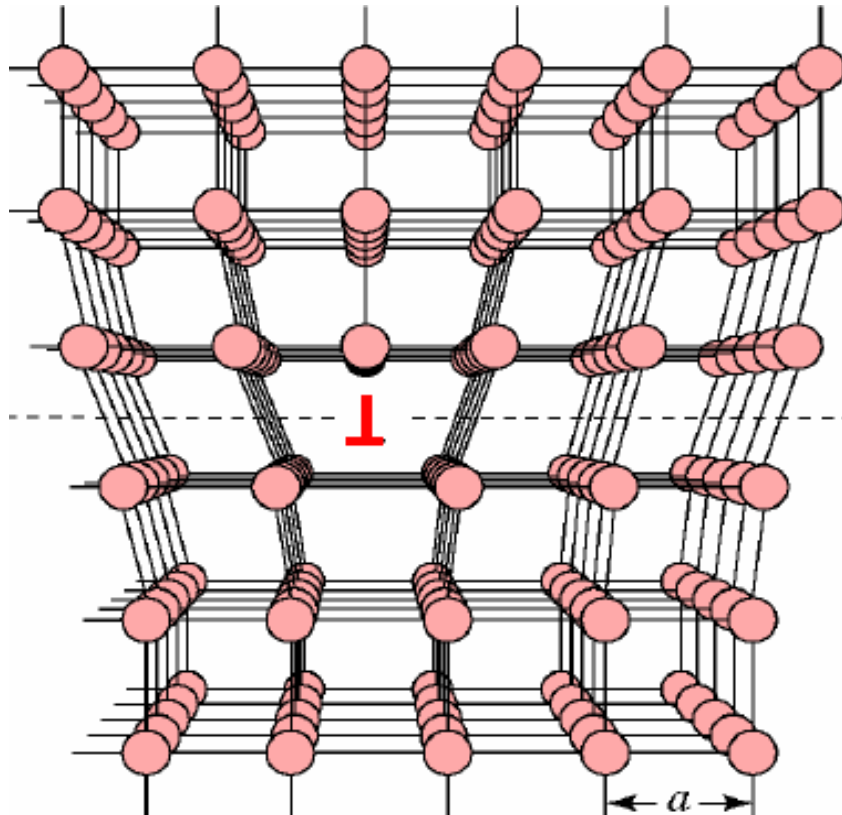
Distorções na
estrutura causados
pelos defeitos
puntiformes

Defeitos de linha - discordâncias

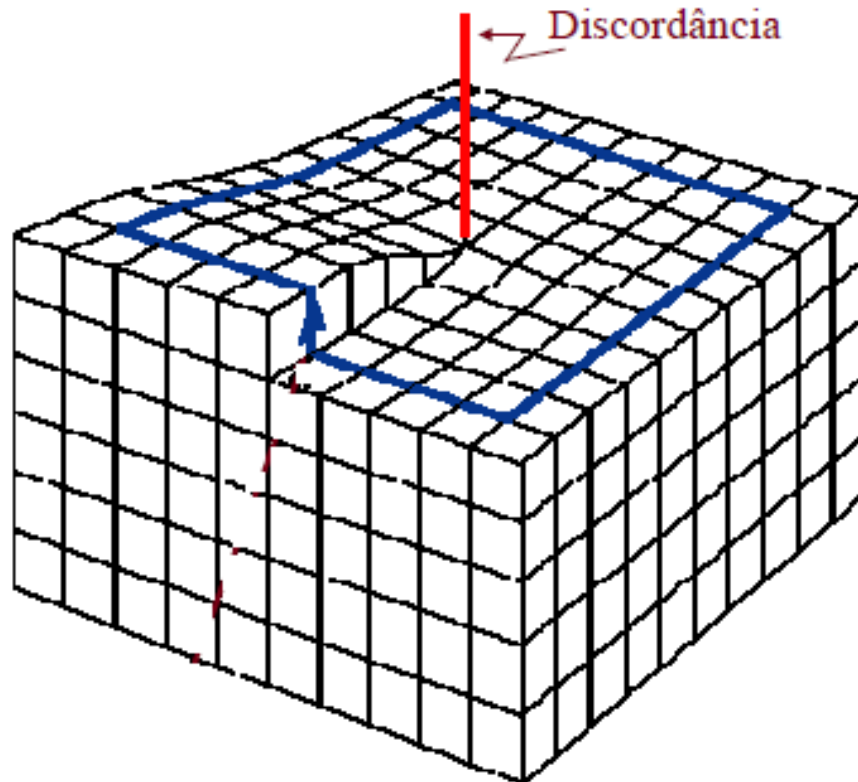


Discordância
em cunha

Defeitos de linha - discordâncias



Defeitos de linha - discordâncias



Discordâncias
em hélice

Defeitos de linha - discordâncias

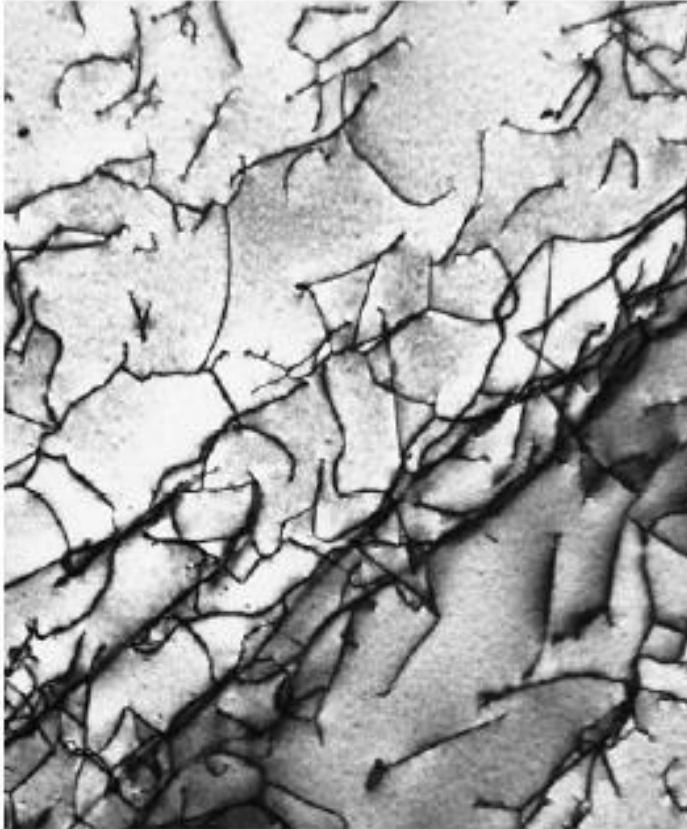
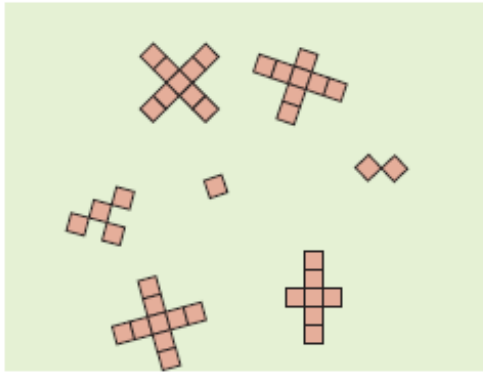
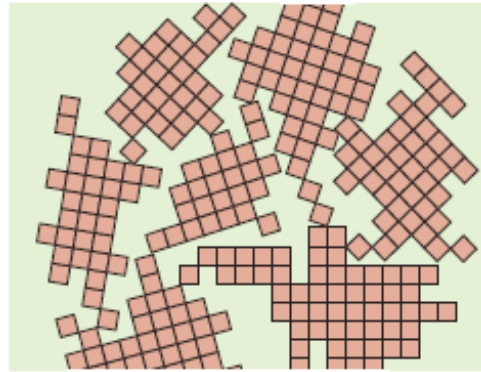


Figure 4.6 A transmission electron micrograph of a titanium alloy in which the dark lines are dislocations. 51,450 \times . (Courtesy of M. R. Plichta, Michigan Technological University.)

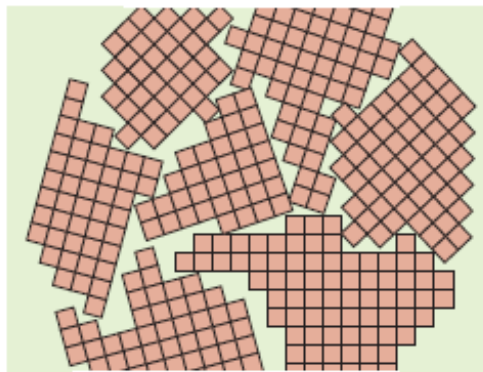
Defeitos de superfície



(a)



(b)



(c)



(d)

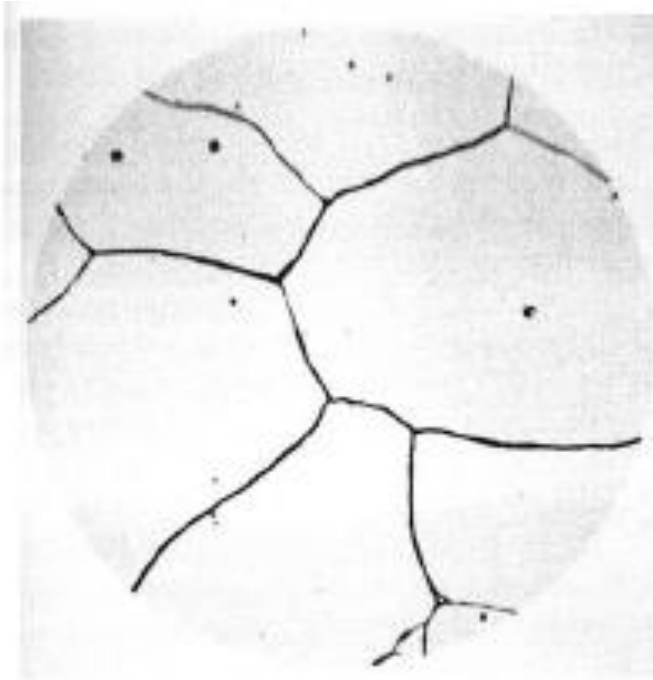
Contornos
de grão

Defeitos de superfície

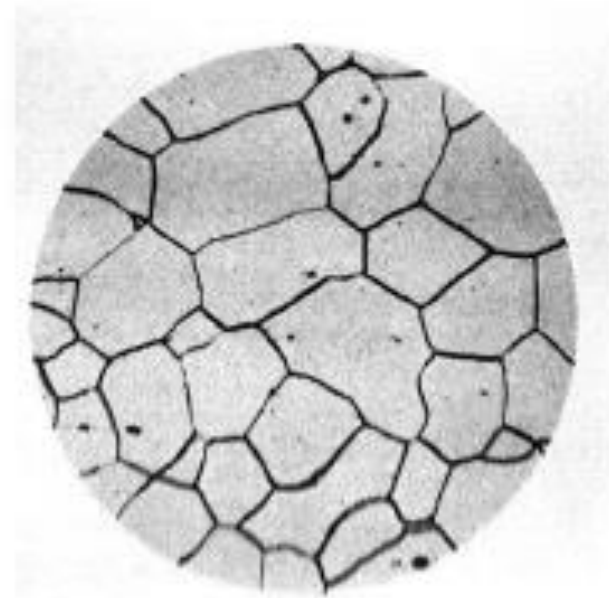


Contornos
de grão

Defeitos de superfície

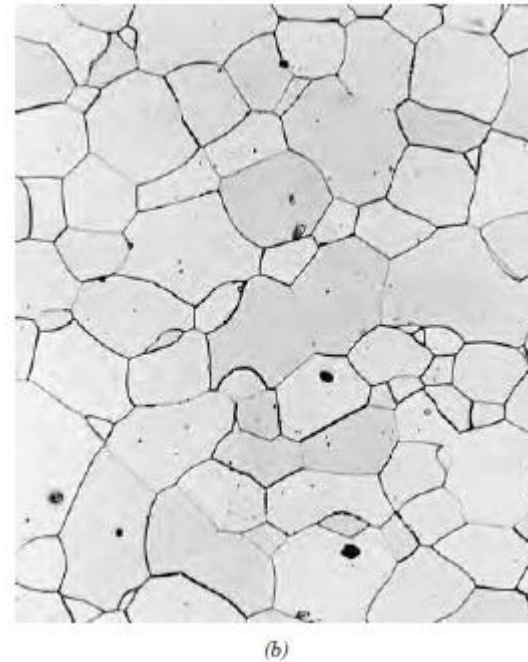
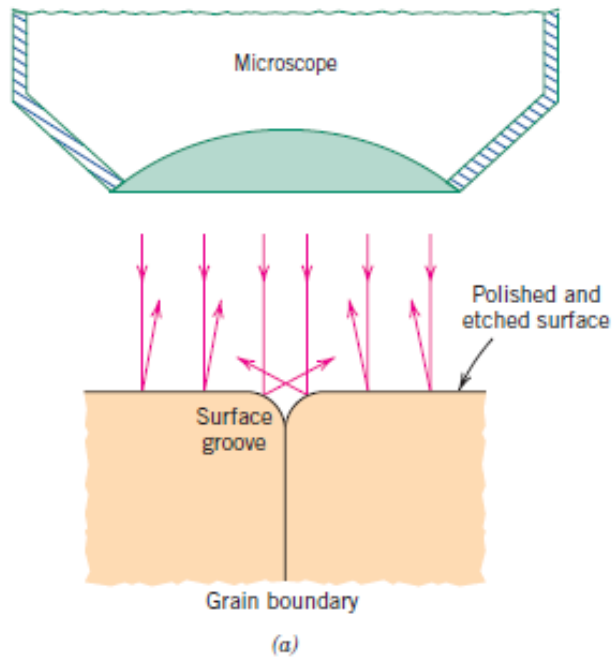


(a) Grain Size, $G = 1$

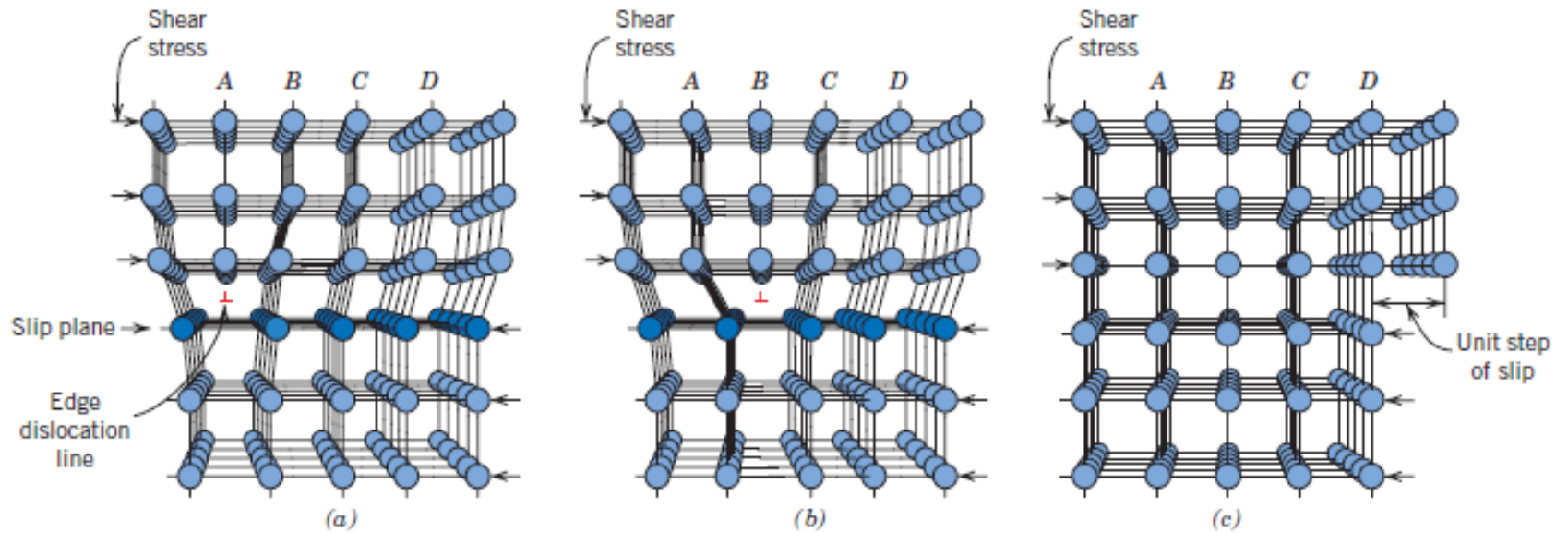


(b) Grain Size, $G = 4$

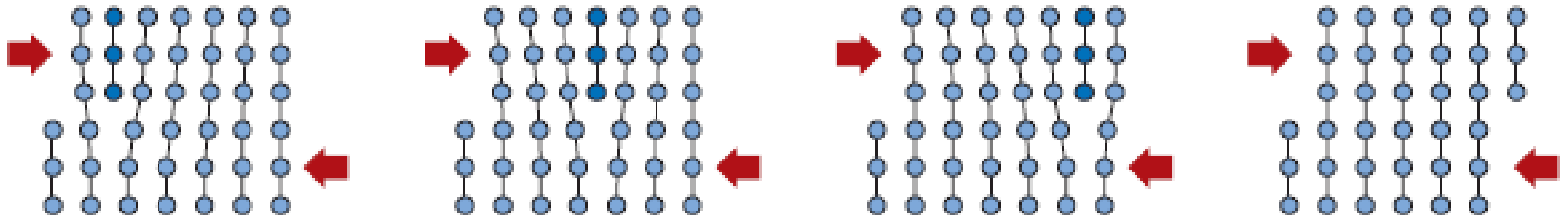
Contornos de grão

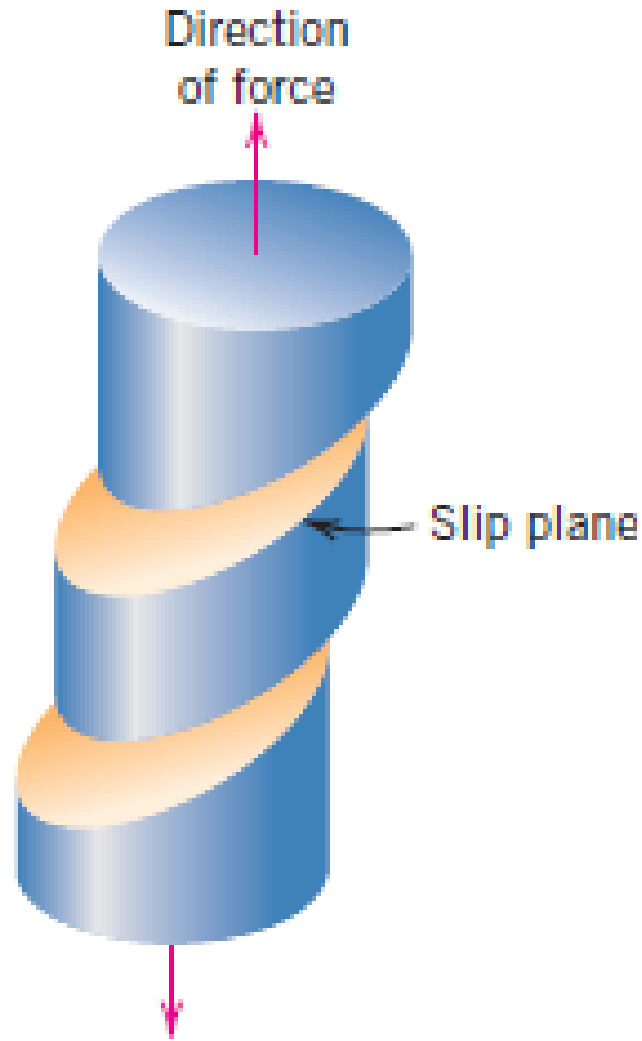


Discordâncias e deformação plástica



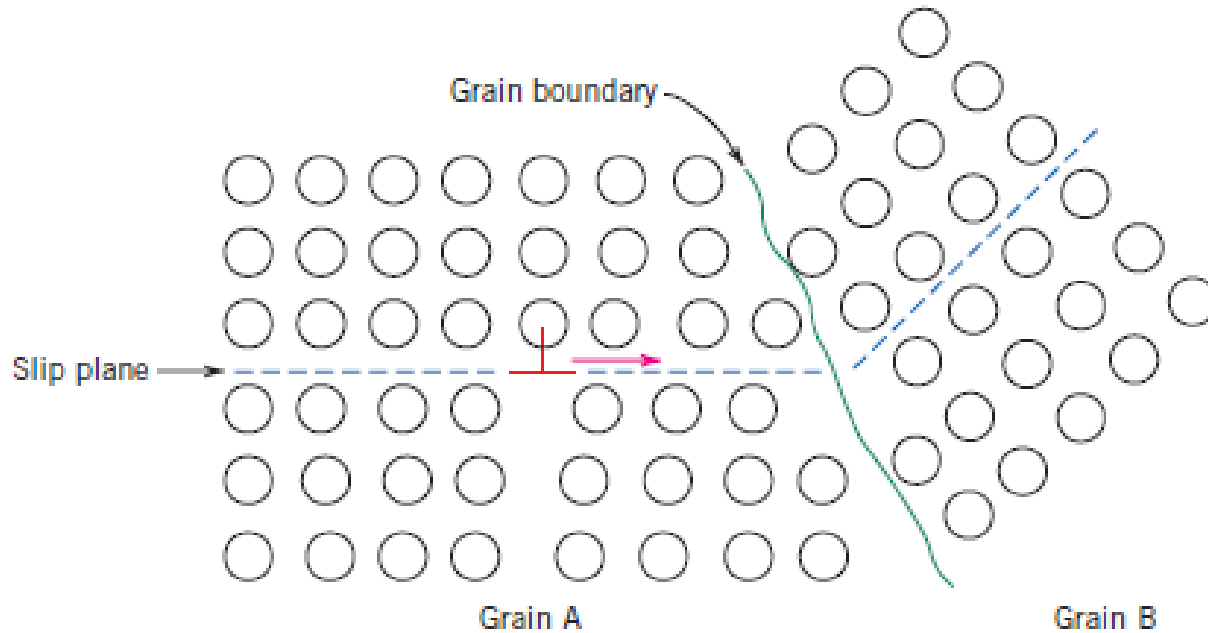
Discordâncias e deformação plástica



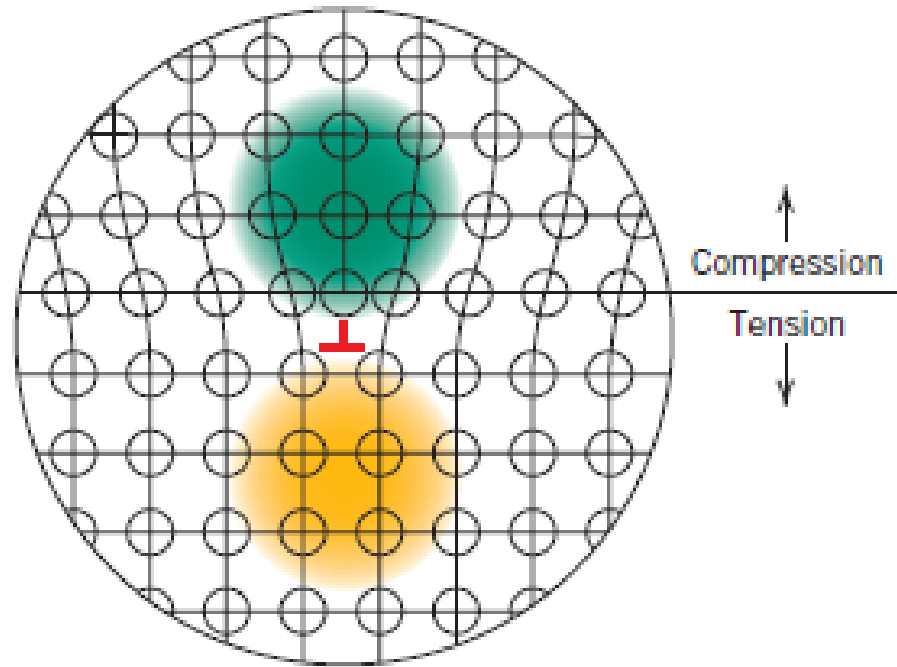




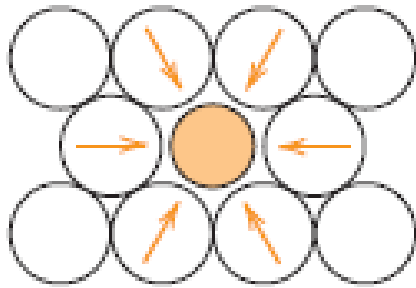
Discordâncias e deformação plástica



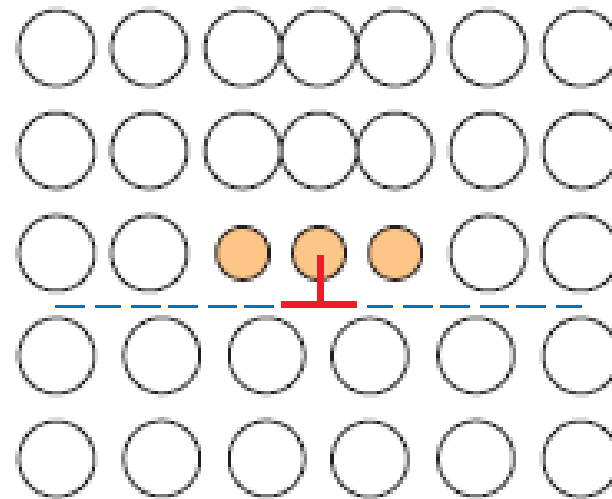
Discordâncias e deformação plástica



Discordâncias e deformação plástica

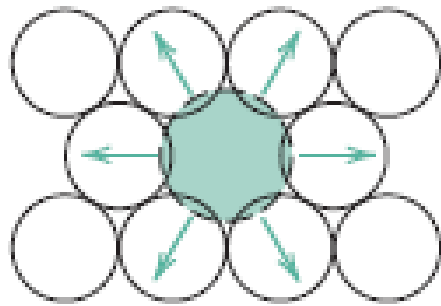


(a)

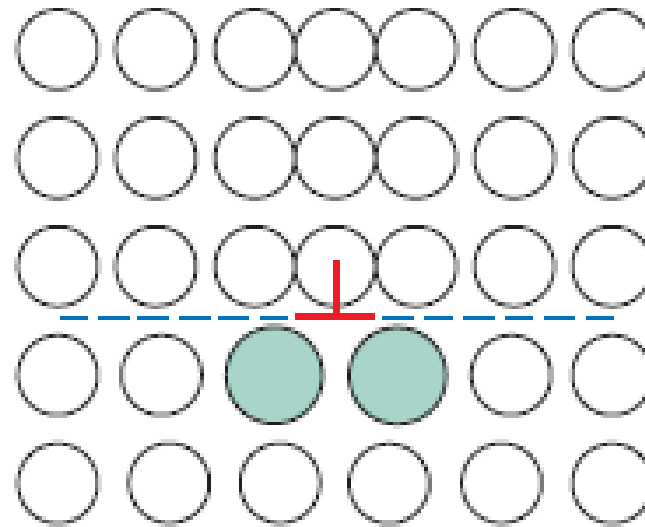


(b)

Discordâncias e deformação plástica



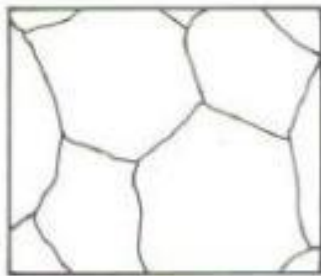
(a)



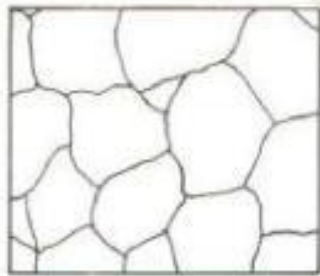
(b)

Mecanismos de endurecimento

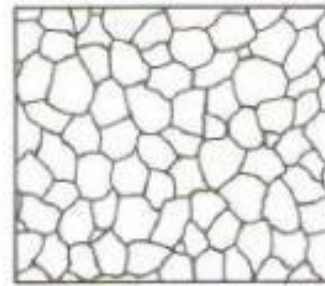
- Redução do tamanho de grão



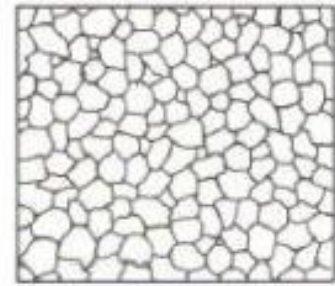
N° 1



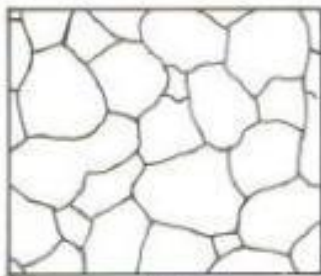
N° 2



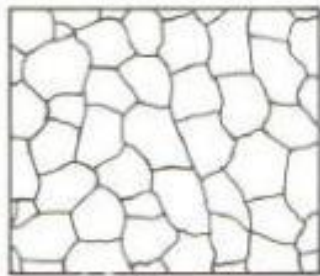
N° 5



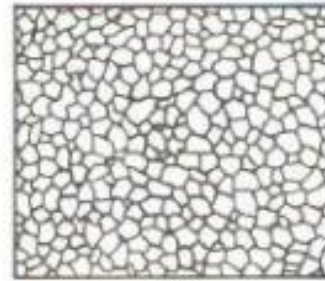
N° 6



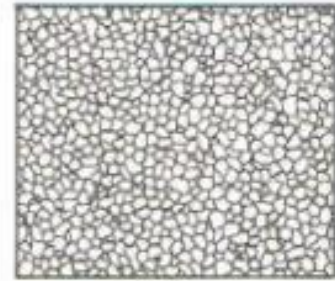
N° 3



N° 4



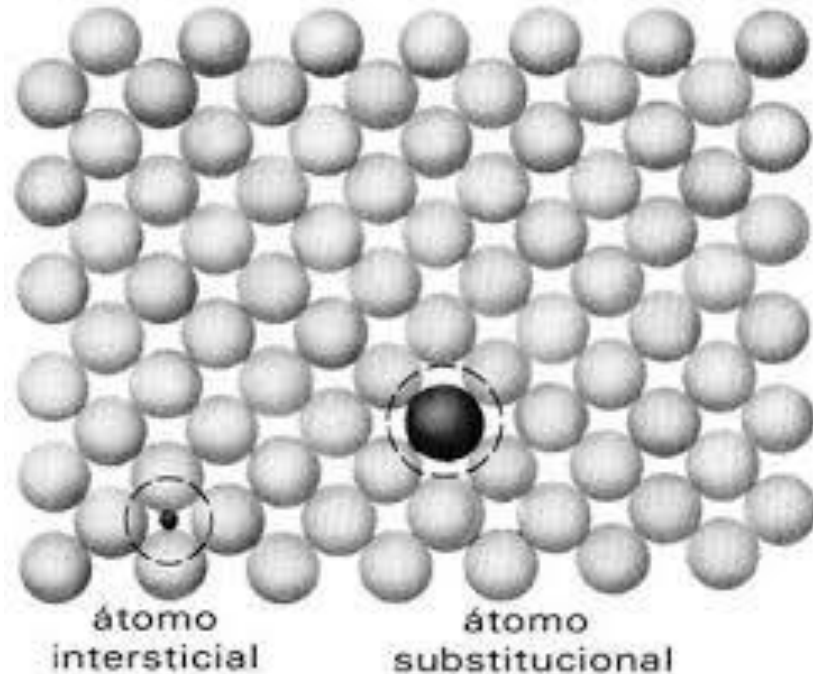
N° 7



N° 8

Mecanismos de endurecimento

- Redução do tamanho de grão
- Solução sólida



Mecanismos de endurecimento

- Redução do tamanho de grão
- Solução sólida
- Encruamento (deformação plástica a frio)

