STEEL MICROSTRUCTURES:
PEARLITE AND MARTENSITE

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Lamellar microstructure is a diffraction grating for visible light

$\gamma \rightarrow \alpha + \text{Fe}_3\text{C}$

Kinetics of transformation:

$$f = 1 - \exp\left[\frac{\pi}{3} NG^3 t^{d+1}\right]$$

N: nucleation rate
G: growth rate
2 < d < 3
Pearlite

- Habit planes
- Characteristic spacing, $\lambda$

$\lambda \propto T$

$\sigma_{h-p} \propto \frac{1}{\sqrt{\lambda}}$

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Martensite Structure

- Named after Adolf Martens
- Diffusionless, military transformation
  - Same chemical composition as parent
  - Sharp interfaces
- Similar to twinning
- $\gamma$ (FCC) $\rightarrow$ M (BCT)
- Not a complete transformation

http://www.cashenblades.com/info/martensite.htm

Image from Wikimedia Commons, http://commons.wikimedia.org
Cu-Al-Ni Austenite to Martensite transformation

Please see the movie at Sethna, Jim. “What are Martensites?” Cornell University, 1996.

http://www.lassp.cornell.edu/sethna/Tweed/Martensite_History.html
Martensite Reaction

\[ \frac{c}{a} = 1.4 \]

\[ 1 < \frac{c}{a} < 1.4 \]

\( \gamma \) (FCC) \hspace{2cm} \text{M (BCT)}

Courtesy of Harry Bhadeshia. Used with permission.

http://www.msm.cam.ac.uk/phasetrans/2003/Lattices/bain.html
Alloying Effects

- Diffusion and growth are slower
- Change in eutectoid temperature
- Change $M_s$ temperature

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THE END