آزمایشگاه مالتولوگرافی

فولادها در دیاگرام تعادلی آهن کربن
Iron-Carbon (Fe-C) Phase Diagram

- 2 important points
  - **Eutectic (A):**
    \[ L \leftrightarrow \gamma + \text{Fe}_3\text{C} \]
  - **Eutectoid (B):**
    \[ \gamma \leftrightarrow \alpha + \text{Fe}_3\text{C} \]

Result: Pearlite = alternating layers of \( \alpha \) and \( \text{Fe}_3\text{C} \) phases, not a separate phase.
Eutectoid reaction:
\[ \gamma \leftrightarrow \alpha + \text{Fe}_3\text{C} \]

- formation of the pearlite structure
  - nucleating at \(\gamma\) grain boundaries
  - growth by diffusion of C to achieve the compositions of \(\alpha\) and \(\text{Fe}_3\text{C}\) (with structural changes)
  - \(\alpha\) lamellae much thicker

Redistribution of carbon by diffusion
- Austenite – 0.76 wt% C
- Ferrite - 0.022 wt% C
- Cementite - 6.70 wt% C
Hypoeutectoid Steel

Microstructures for iron-iron carbide alloys that are below the eutectoid with compositions between 0.022 and 0.76 wt% Carbon are hypoeutectoid.
Solution to Example Problem

a) Using the RS tie line just below the eutectoid

\[ C_\alpha = 0.022 \text{ wt}\% \text{ C} \]
\[ C_{\text{Fe}_3\text{C}} = 6.70 \text{ wt}\% \text{ C} \]

b) Using the lever rule with the tie line shown

\[
W_{\text{Fe}_3\text{C}} = \frac{R}{R + S} = \frac{C_0 - C_\alpha}{C_{\text{Fe}_3\text{C}} - C_\alpha}
\]
\[
= \frac{0.40 - 0.022}{6.70 - 0.022} = 0.057
\]

Amount of Fe₃C in 100 g
\[
= (100 \text{ g})W_{\text{Fe}_3\text{C}}
\]
\[
= (100 \text{ g})(0.057) = 5.7 \text{ g}
\]
Proeutectoid

- Formed before the eutectoid
- Ferrite that is present in the pearlite is called eutectoid ferrite.
- The ferrite that is formed above the $T_{\text{eutectoid}}$ ($727^\circ C$) is proeutectoid.
Microstructures for iron-iron carbide alloys that have compositions between 0.76 and 2.14 wt% carbon are hypereutectoid (more than eutectoid).
Hypereutectoid Steel (1.2 wt% C)

Proeutectoid: formed above the $T_{\text{eutectoid}}$ (727°C)