آزمایشگاه متالوگرافی

فولادها در دیاگرام تعادلی آهن کربن

Iron-Carbon (Fe-C) Phase Diagram

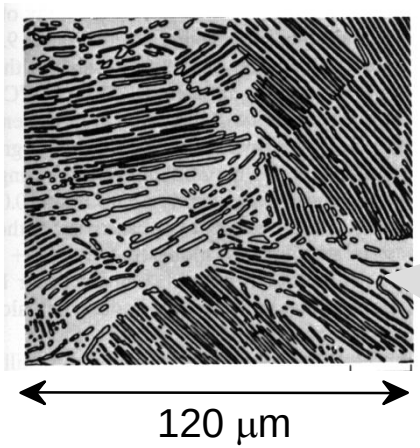
- 2 important points

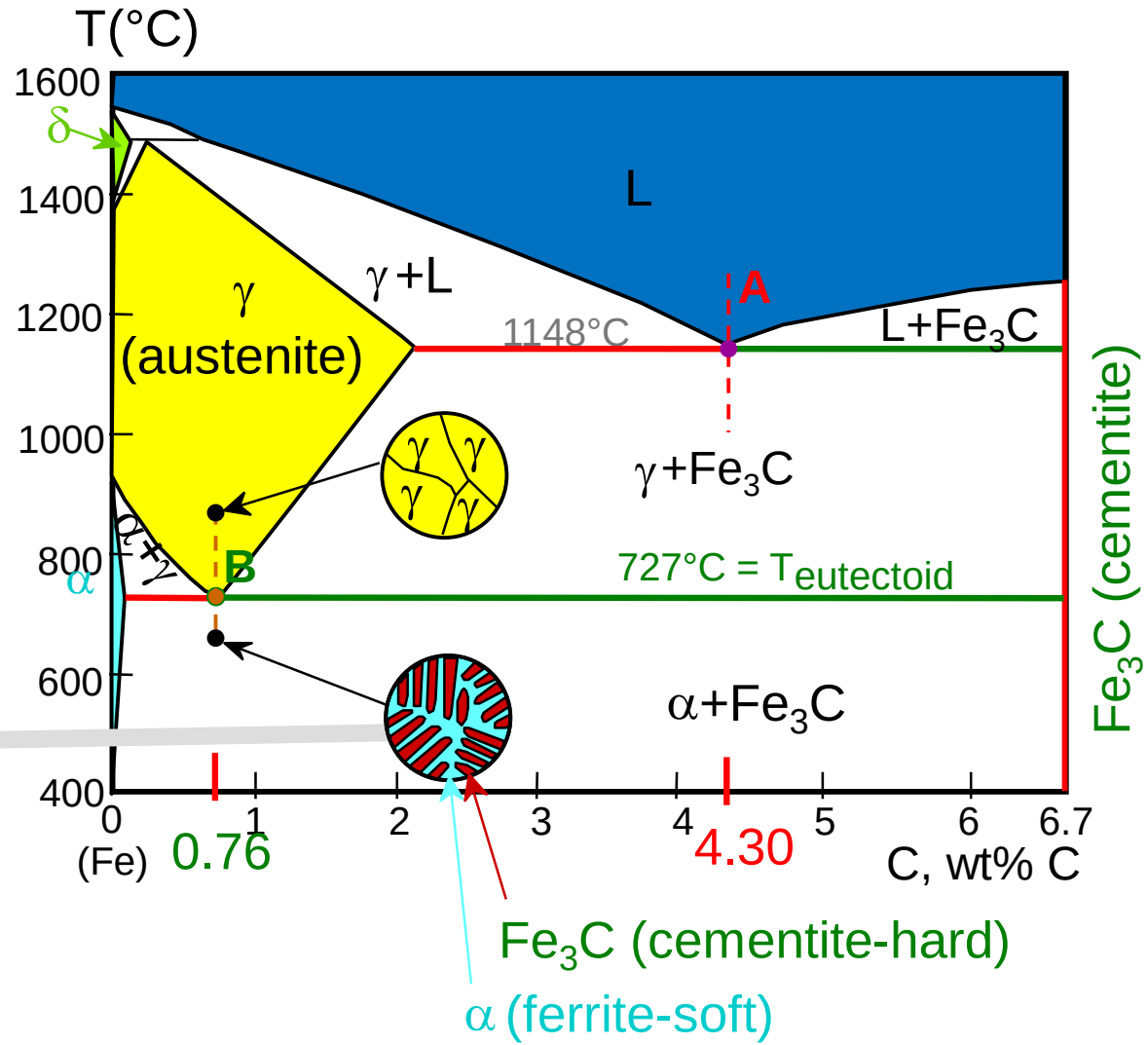
- Eutectic (A):

$L \leftrightarrow \gamma + Fe_3C$

- Eutectoid (B):

$\gamma \leftrightarrow \alpha + Fe_3C$



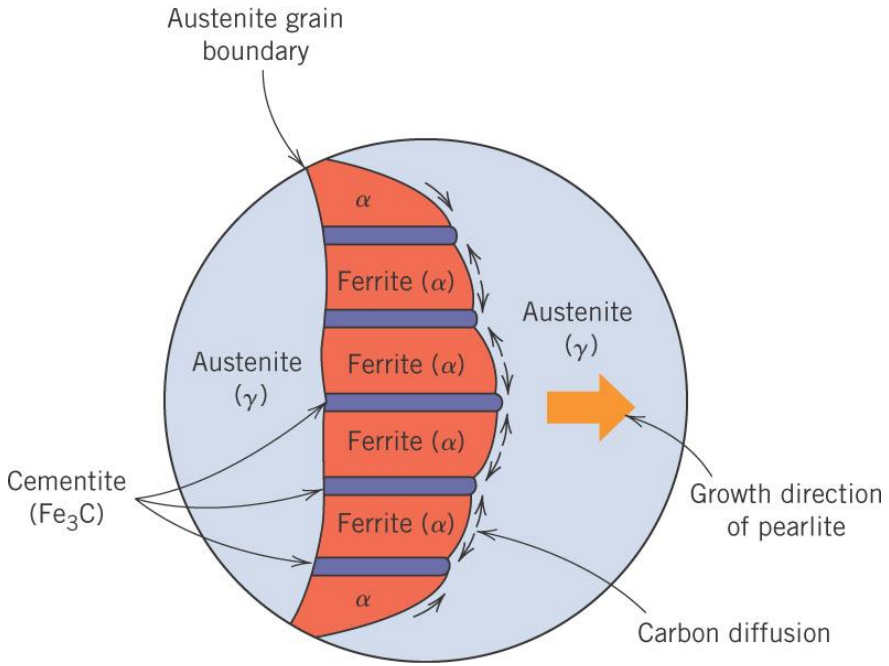


Result: Pearlite = alternating layers of α and Fe_3C phases, not a separate phase.

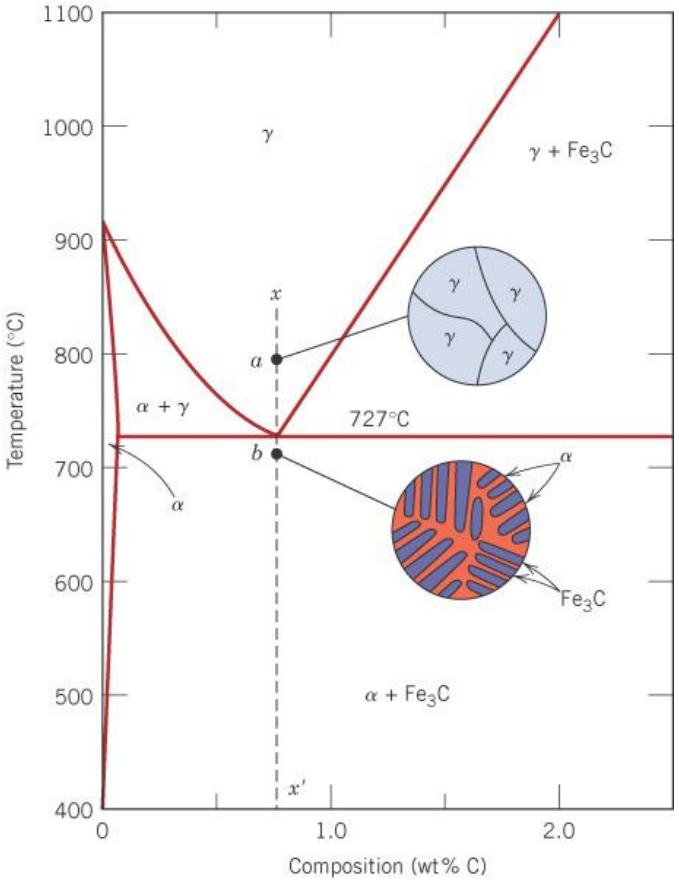
Eutectoid reaction:

$$\gamma \leftrightarrow \alpha + Fe_3C$$

- formation of the pearlite structure
  - nucleating at γ grain boundaries
  - growth by diffusion of C to achieve the compositions of α and Fe_3C (with structural changes)
  - α lamellae much thicker

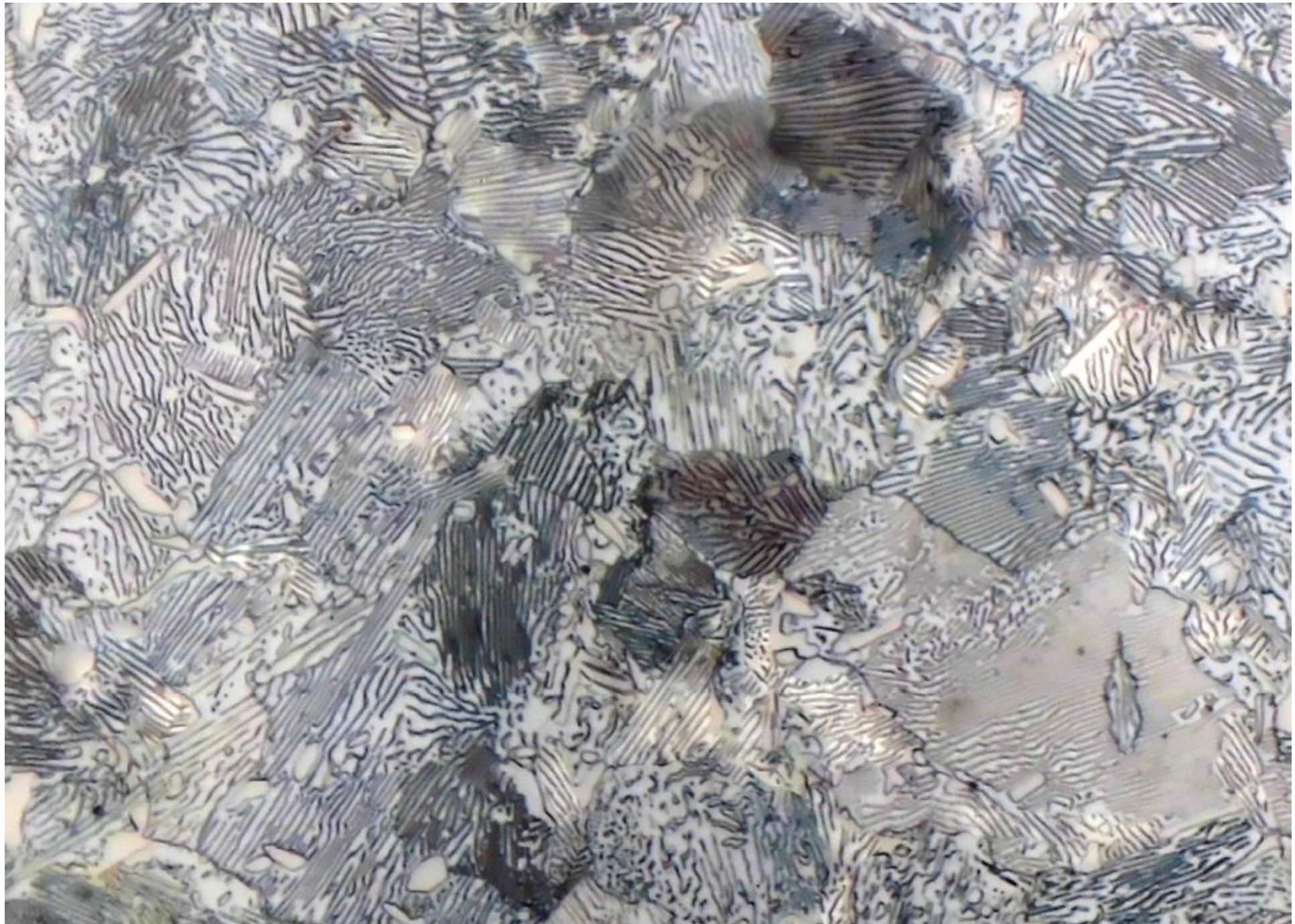


Pearlite

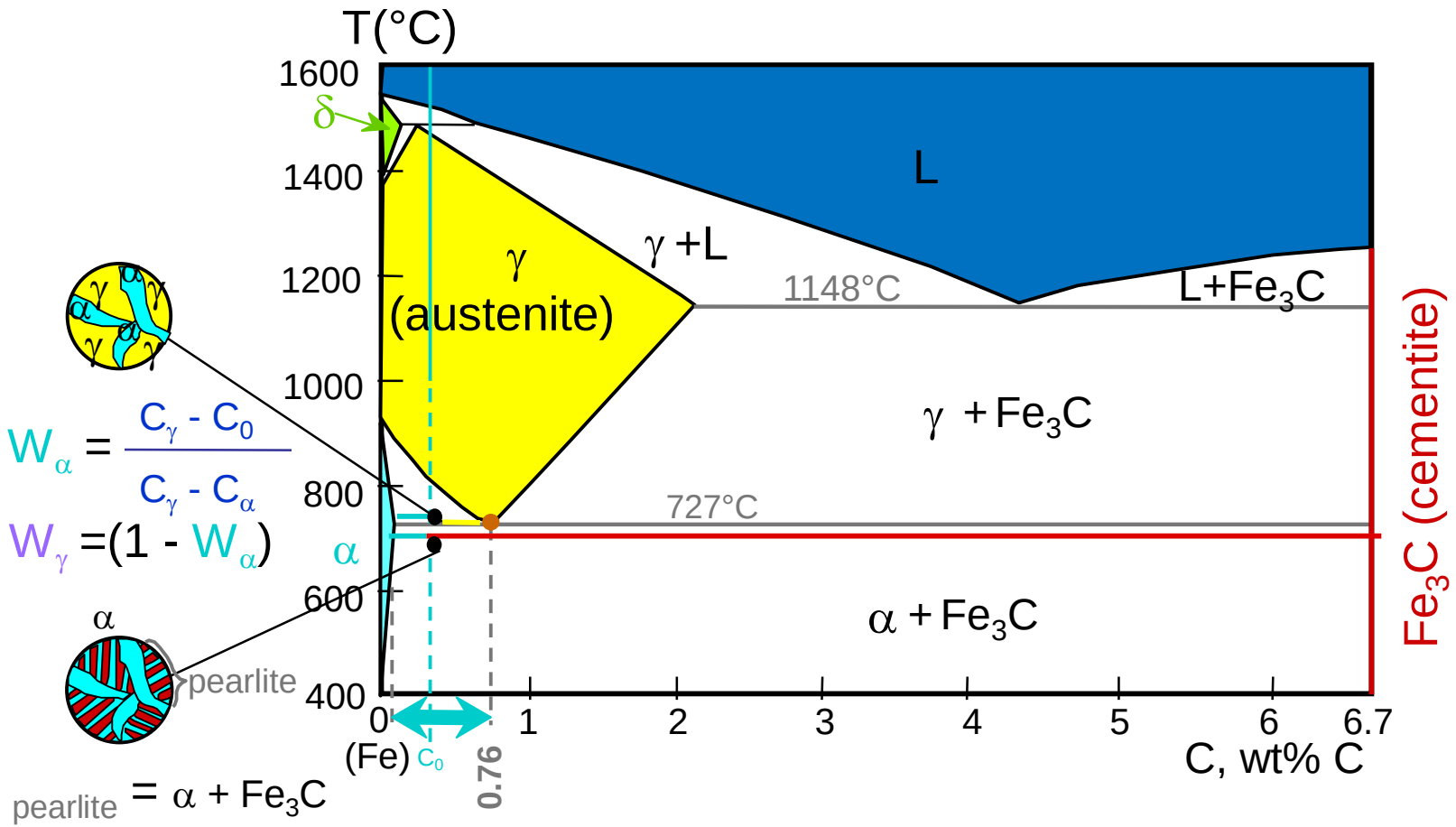


Redistribution of carbon by diffusion

Austenite – 0.76 wt% C
Ferrite - 0.022 wt% C
Cementite - 6.70 wt% C



Hypoeutectoid Steel



$$W_\alpha = \frac{C_\gamma - C_0}{C_\gamma - C_\alpha}$$

$$W_\gamma = (1 - W_\alpha)$$

pearlite = $\alpha + Fe_3C$

$$W_{\alpha'} = \frac{C_{Fe3C} - C_0}{C_{Fe3C} - C_\alpha}$$

$$W_{pearlite} = (1 - W_{\alpha'})$$

Microstructures for iron-iron carbide alloys that are <u>below</u> 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_α = 0.022 wt% C

C_{Fe_3C} = 6.70 wt% C

b) Using the lever rule with the tie line shown

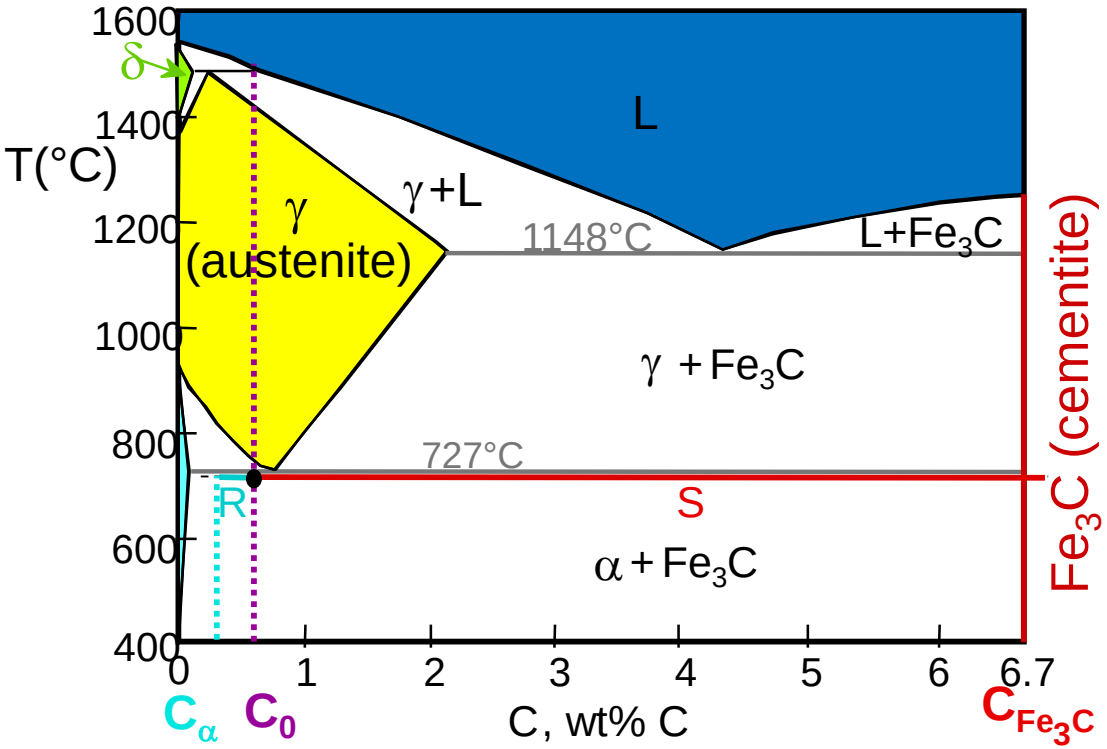
$$W_{Fe_3C} = \frac{R}{R+S} = \frac{C_0 - C_\alpha}{C_{Fe_3C} - C_\alpha}$$

$$= \frac{0.40 - 0.022}{6.70 - 0.022} = 0.057$$

Amount of Fe_3C in 100 g

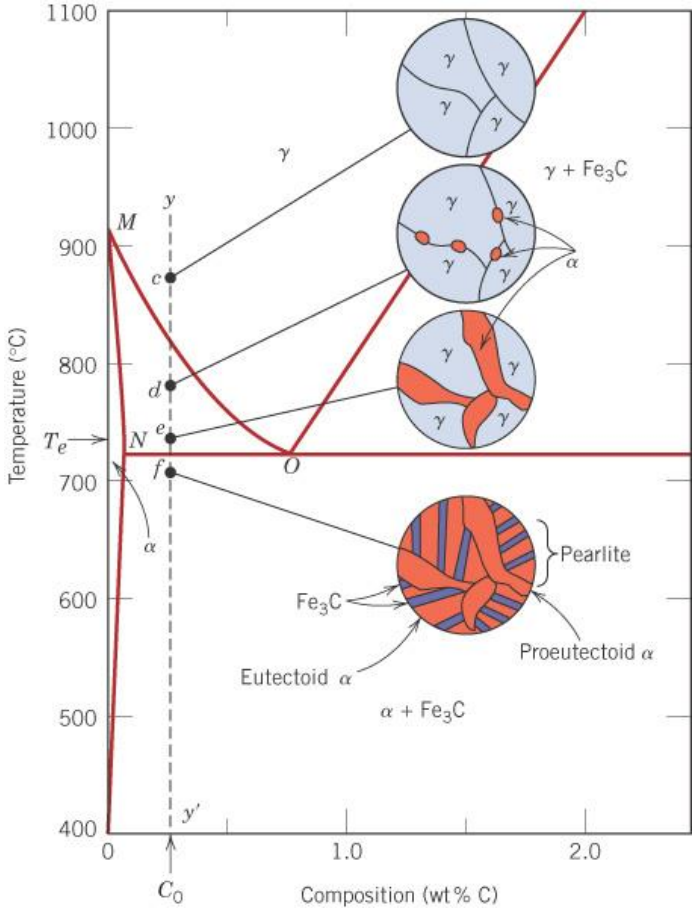
= (100 g)W_{Fe_3C}

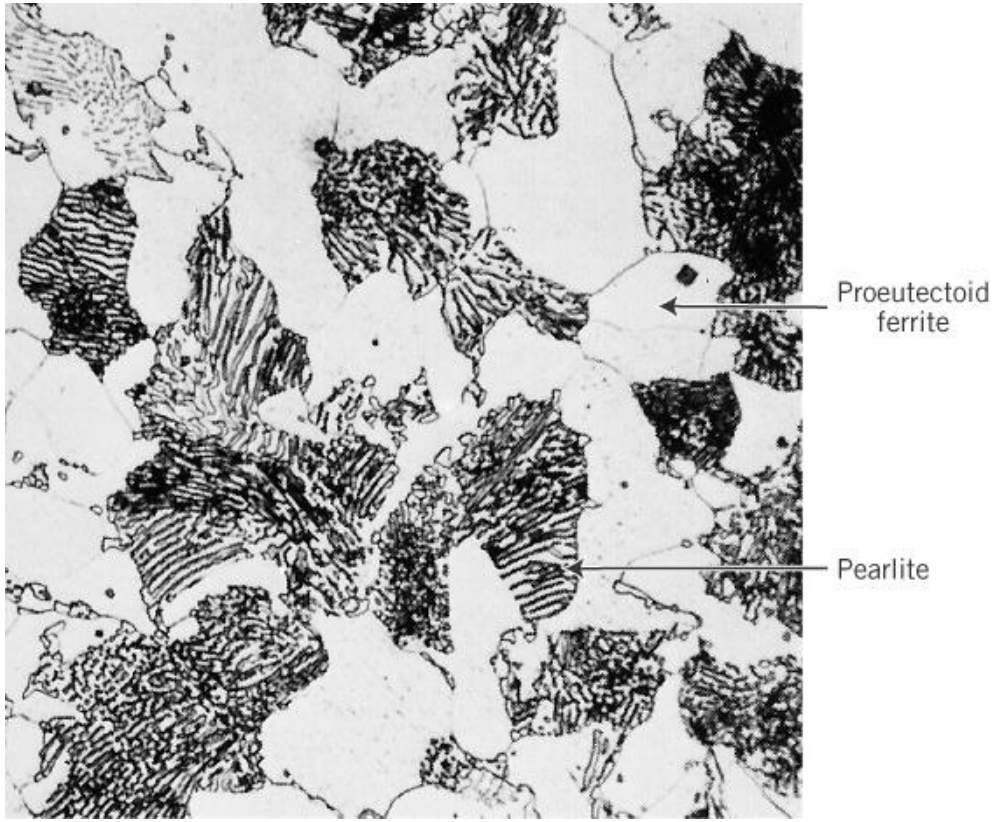
= (100 g)(0.057) = 5.7 g



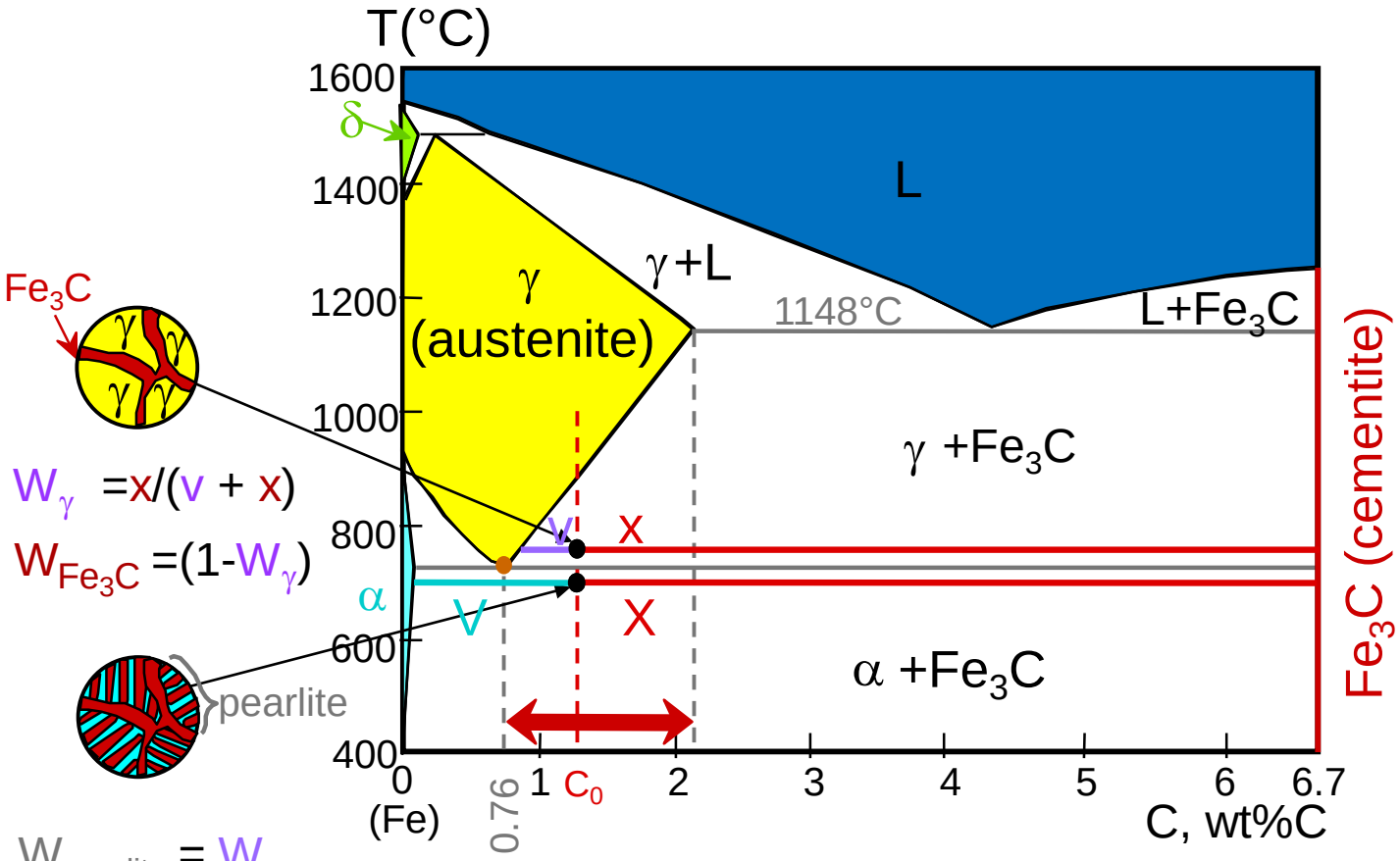
Proeutectoid

- Formed before the eutectoid
- Ferrite that is present in the pearlite is called eutectoid ferrite.
- The ferrite that is formed above the $T_{eutectoid}$ (727°C) is proeutectoid.





Hypereutectoid Steel



$W_\gamma = x/(v + x)$

$W_{Fe_3C} = (1 - W_\gamma)$

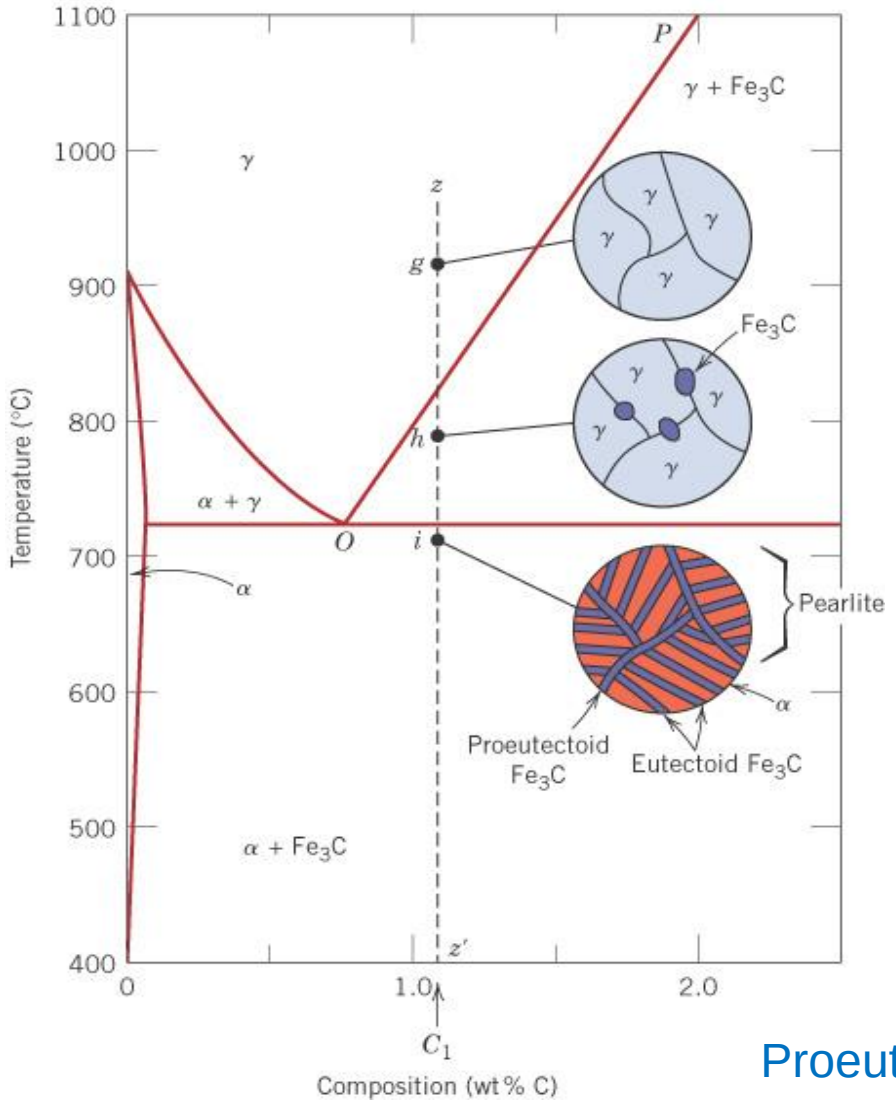
$W_{pearlite} = W_\gamma$

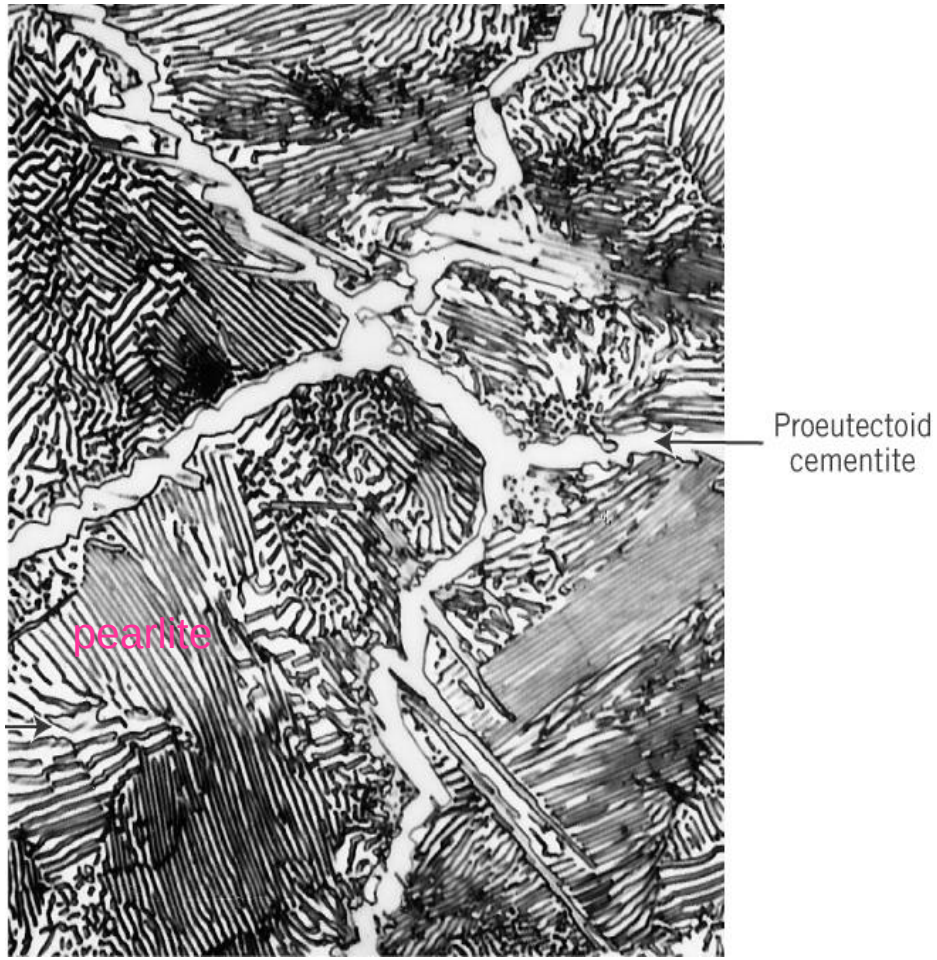
$W_\alpha = X/(V + X)$

$W_{Fe_3C'} = (1 - W_\alpha)$

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 $T_{eutectoid}$ (727°C)