آزمایشگاه متالوگرافی

دیاگرام تعادلی آهن–کربن
• Pure iron when heated experiences 2 changes in crystal structure before it melts.
• At room temperature the stable form, ferrite (α iron) has a BCC crystal structure.
• Ferrite experiences a polymorphic transformation to FCC austenite (γ iron) at 912 °C (1674 °F).
• At 1394 °C (2541 °F) austenite reverts back to BCC phase δ ferrite and melts at 1538 °C (2800 °F).
• Iron carbide (cementite or Fe₃C) an intermediate compound is formed at 6.7 wt% C.
• Typically, all steels and cast irons have carbon contents less than 6.7 wt% C.
• Carbon is an interstitial impurity in iron and forms a solid solution with the α, γ, δ phases.
• **α-ferrite**
  - solid solution of carbon in a iron,
  - BCC structure
  - carbon only slightly soluble in the matrix
    - maximum solubility of 0.02% C at 723°C to about 0.008% C at room temperature.
• **Austenite (γ)**
  - solid solution of carbon in γ-iron
  - FCC structure: can accommodate more carbon than ferrite
    - maximum of 2.08% C at 1148°C, decreases to 0.8% C at 723°C
    - difference in C solid solubility between γ and α is the basis for hardening of most steels.

δ-ferrite
  - solid solution of carbon in δ-iron
  - BCC crystal structure
    - maximum solubility of ferrite being 0.09% C at 1495°C

• **Cementite (Fe₃C)**
  - intermetallic Fe-C compound
    - Fe₃C : 6.67%C and 93.3%Fe.
  - orthorhombic crystal structure: hard and brittle
Iron carbide (Cementite or Fe$_3$C)

- Forms when the solubility limit of carbon in $\alpha$ ferrite is exceeded at temperatures below 727 °C.
- Mechanically, cementite is very hard and brittle.
- For ferrous alloys there are 3 basic types, based on carbon content:
  - Iron (ferrite phase): <0.008 wt% C at room temp
  - Steel ($\alpha$ + Fe$_3$C phase): 0.008 to 2.14 wt% C
  - Cast iron: 2.14 to 6.70 wt% C