Definition of structures

- **Ledeburite** is the eutectic mixture of austenite and cementite.
- It contains 4.3 percent C and is formed at 1130°C.

Martensite - a super-saturated solid solution of carbon in ferrite.

It is formed when steel is cooled so rapidly that the change from austenite to pearlite is suppressed.

The interstitial carbon atoms distort the BCC ferrite into a BC-tetragonal structure (BCT).; responsible for the hardness of quenched steel

Various Features of Fe-C diagram

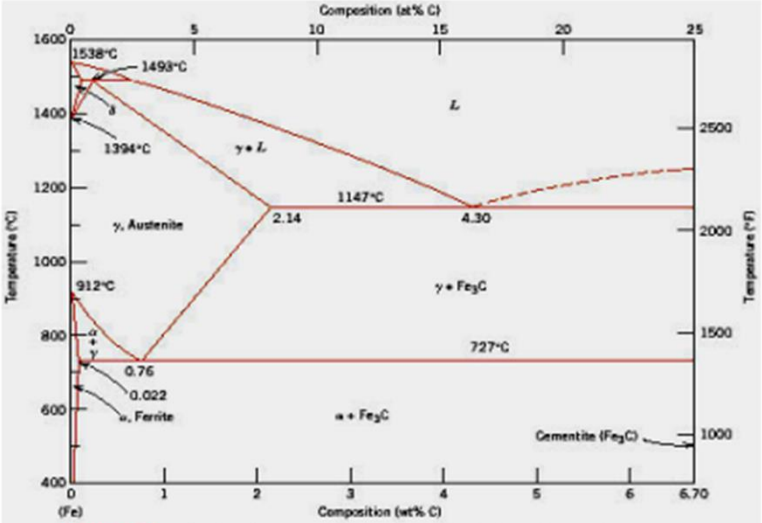


FIGURE 9.22 The iron–iron carbide phase diagram. (Adapted from *Binary Alloy Phase Diagrams*, 2nd edition, Vol. 1, T. B. Massalski, Editor-in-Chief, 1990. Reprinted by permission of ASM International, Materials Park, OH.)

Phases present

- Liquid(l)
- δ:BCC structure,Paramagnetic
- α ferrite:BCC structure, Ferromagnetic,Fairly ductile
- γ austenite:FCC structure, Non-magnetic,Ductile
- Fe_3C cementite:Orthorhombic,Hard, brittle

Reactions

Peritectic $L + \delta = \gamma$

Eutectic $L = \gamma + Fe_3C$

Eutectoid $\gamma = \alpha + Fe_3C$

Max. solubility of C in ferrite=0.022%

Max. solubility of C in austenite=2.11%

Three Phase Reactions

A horizontal line always indicates an invariant reaction in binary phase diagrams

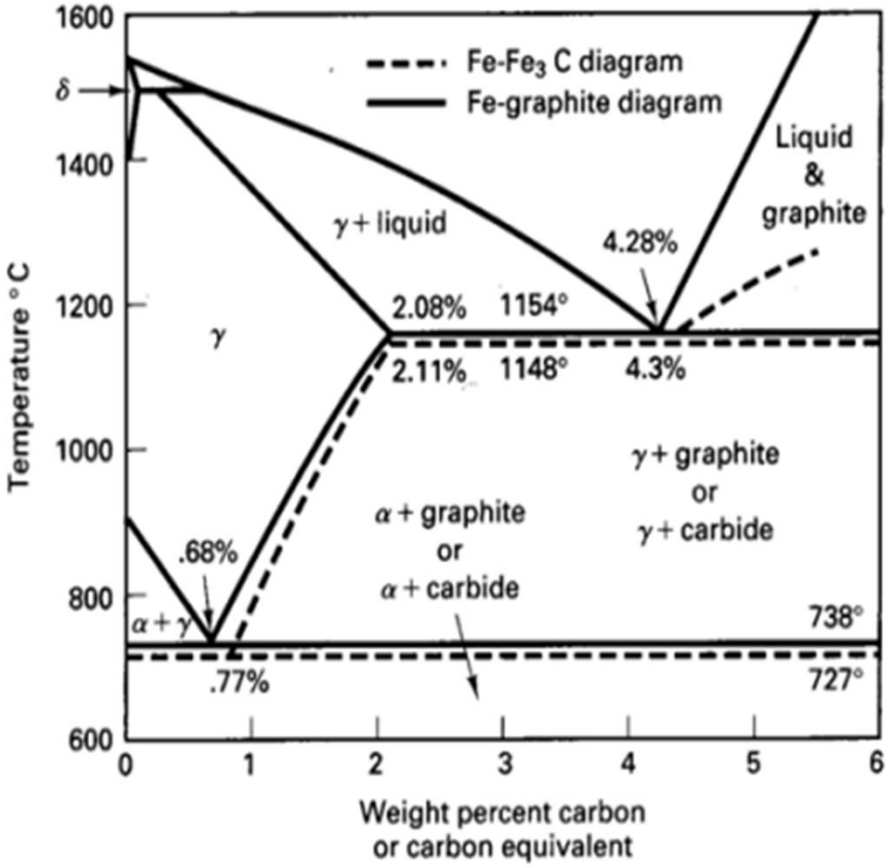
- Peritectic reaction at 1495˚C and 0.18%C,
  - δ-ferrite + $L \leftrightarrow$ γ-iron (austenite)
  - (almost no engineering importance).
- Eutectic reaction at 1147˚C and 4.3 %C,
  - $L \leftrightarrow$ γ-iron + Fe_3C (cementite) [ledeburite]
  - alloys called cast irons
- Eutectoid reaction at 727˚C and 0.77%C,
  - γ-iron $\leftrightarrow$ α–ferrite+Fe_3C (cementite) [pearlite]
  - They are steels

Cast Irons

-Iron-Carbon alloys of 2.11%C or more are cast irons.

-Typical composition: 2.0-4.0%C,0.5-3.0% Si, less than 1.0% Mn and less than 0.2% S.

-Si-substitutes partially for C and promotes formation of graphite as the carbon rich component instead Fe_3C.



The Austenite to ferrite / cementite transformation in relation to Fe-C diagram

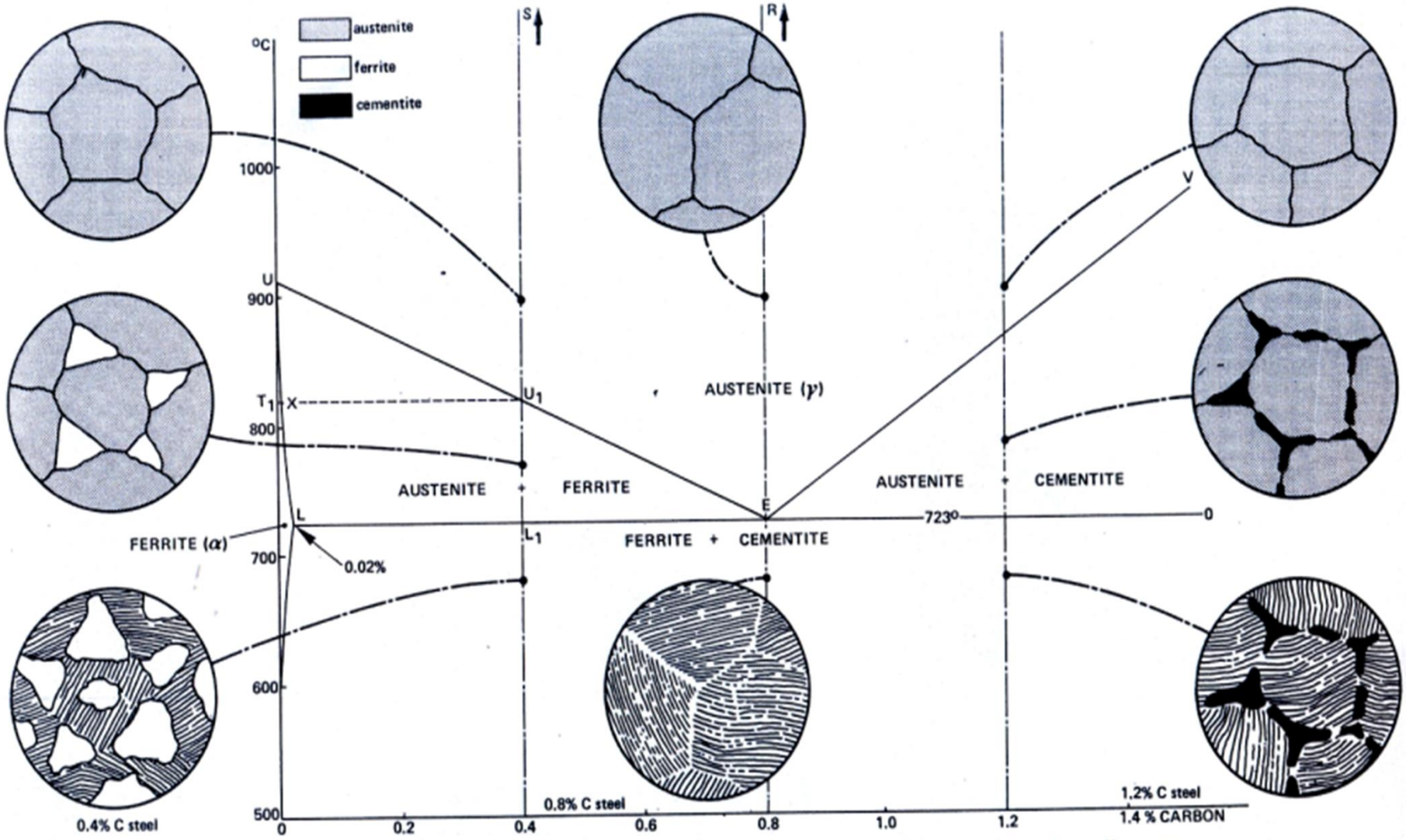


Fig. 9.3—The austenite → ferrite/cementite transformation in relation to the iron–carbon diagram.

Principal phases of steel and their Characteristics

Phase	Crystal structure	Characteristics
Ferrite	BCC	Soft, ductile, magnetic
Austenite	FCC	Soft, moderate strength, non-magnetic
Cementite	Compound of Iron & Carbon Fe_3C	Hard &brittle