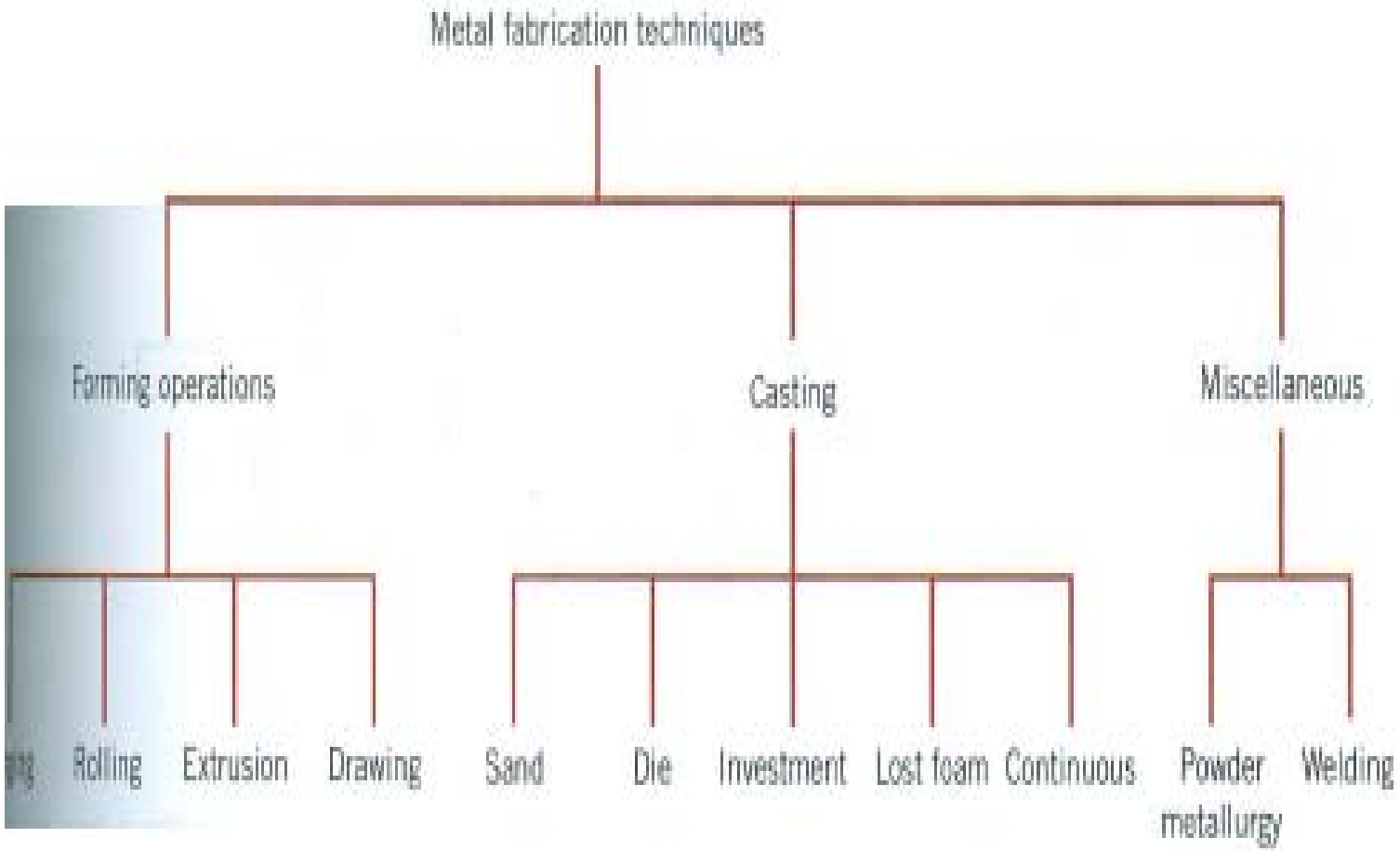
10. Fabrication of metals

Structural metallic materials



Classification scheme of metal fabrication techniques discussed in this chapter.

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Structural metallic materials

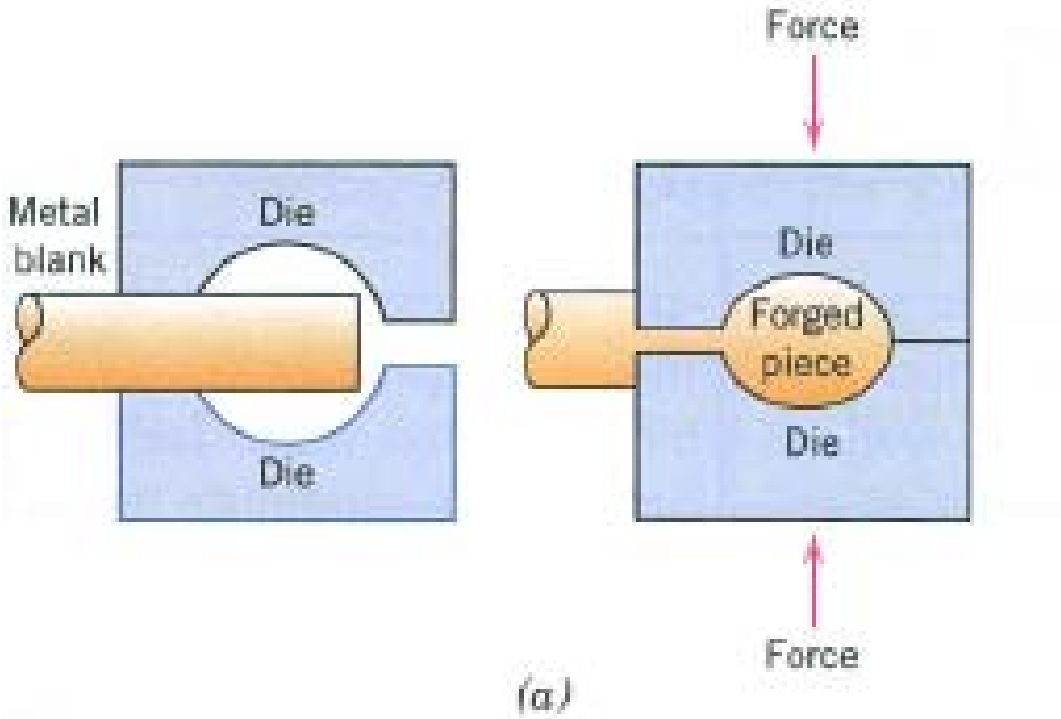
Hot working: any metal-forming operation that is performed above A metal's recrystallization temperature

Cold working: the plastic deformation of a metal at a temperature Below that at which it recrystallizes

Structural metallic materials

10.1 FORMING OPERATONS

10.1.1Forging: mechanical forming of a metal by heating and hammering



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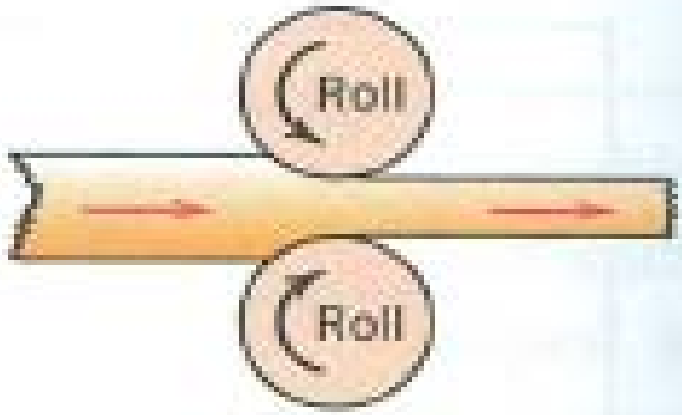
Die forging:

- To achieve complex geometrical details
- Then machined: material removing around 90%

Structural metallic materials

10.1 FORMING OPERATONS

10.1.2Rolling: A metal-forming operation that reduces the thickness of sheet stock; also, elongated shapes may be fashioned using grooved circular rolls



(b)

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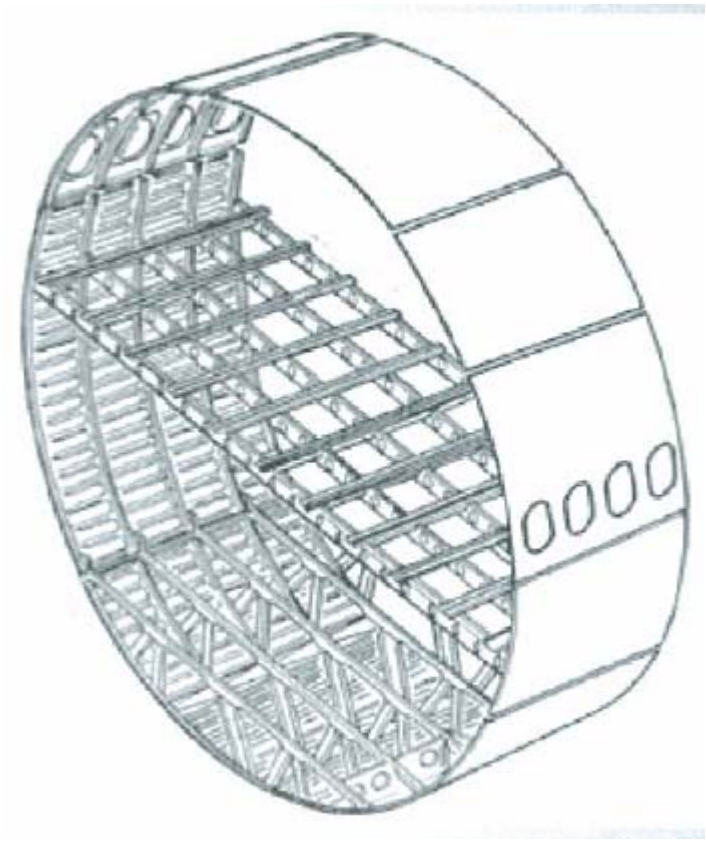
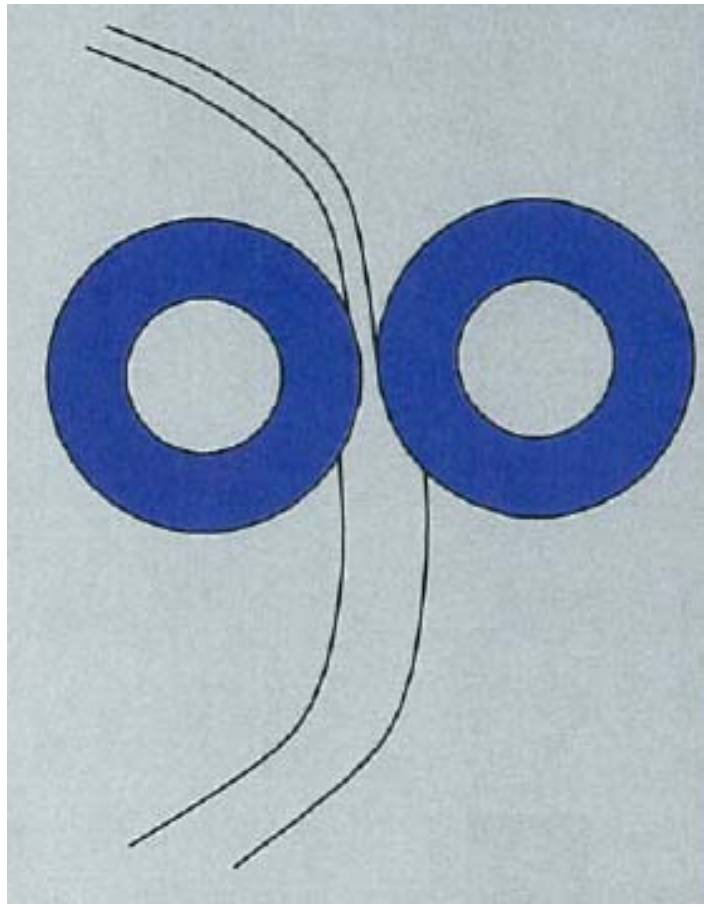
Structural metallic materials

Circular rolling of frame : to get fibred single-piece part

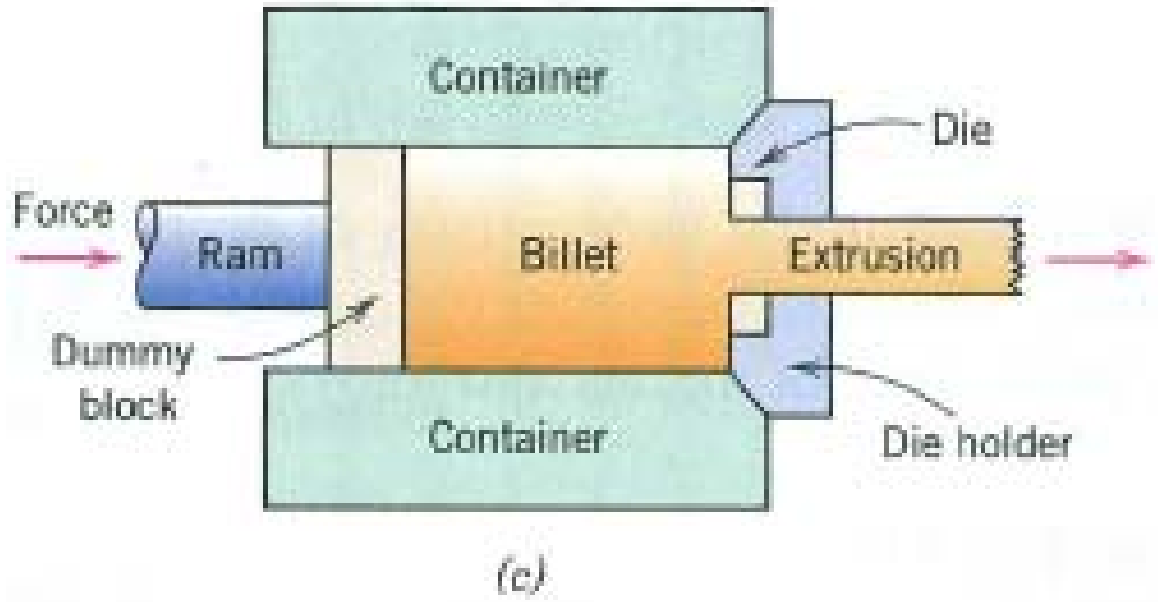




Structural metallic materials

10.1 FORMING OPERATONS

10.1.3 Extrusion: A forming technique where by a material is forced, by compression, through a die orifice

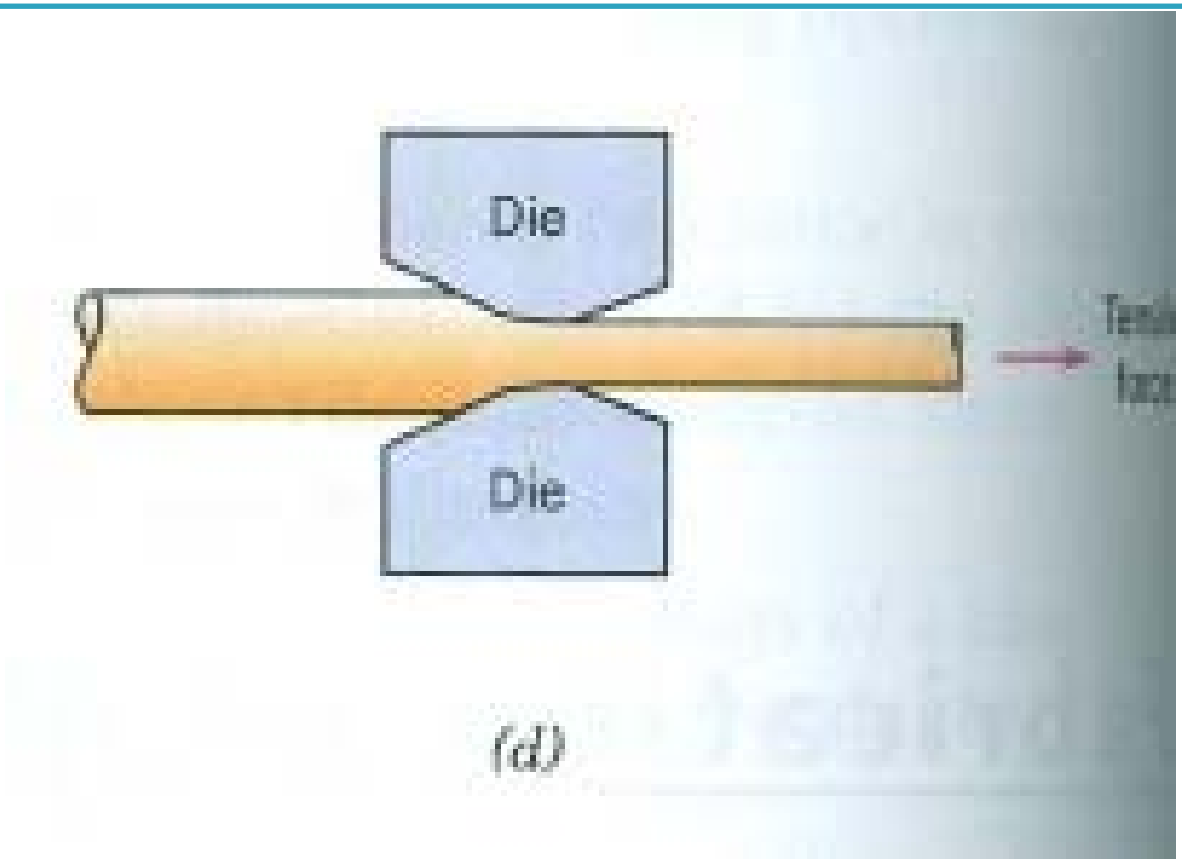


SIAE

Structural metallic materials

10.1 FORMING OPERATONS

10.1.4 Drawing : A forming technique used to fabricate metal wire and tubing. Deformation is accomplished by pulling the material through a die by means of a tensile force applied on the exit side.



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Structural metallic materials

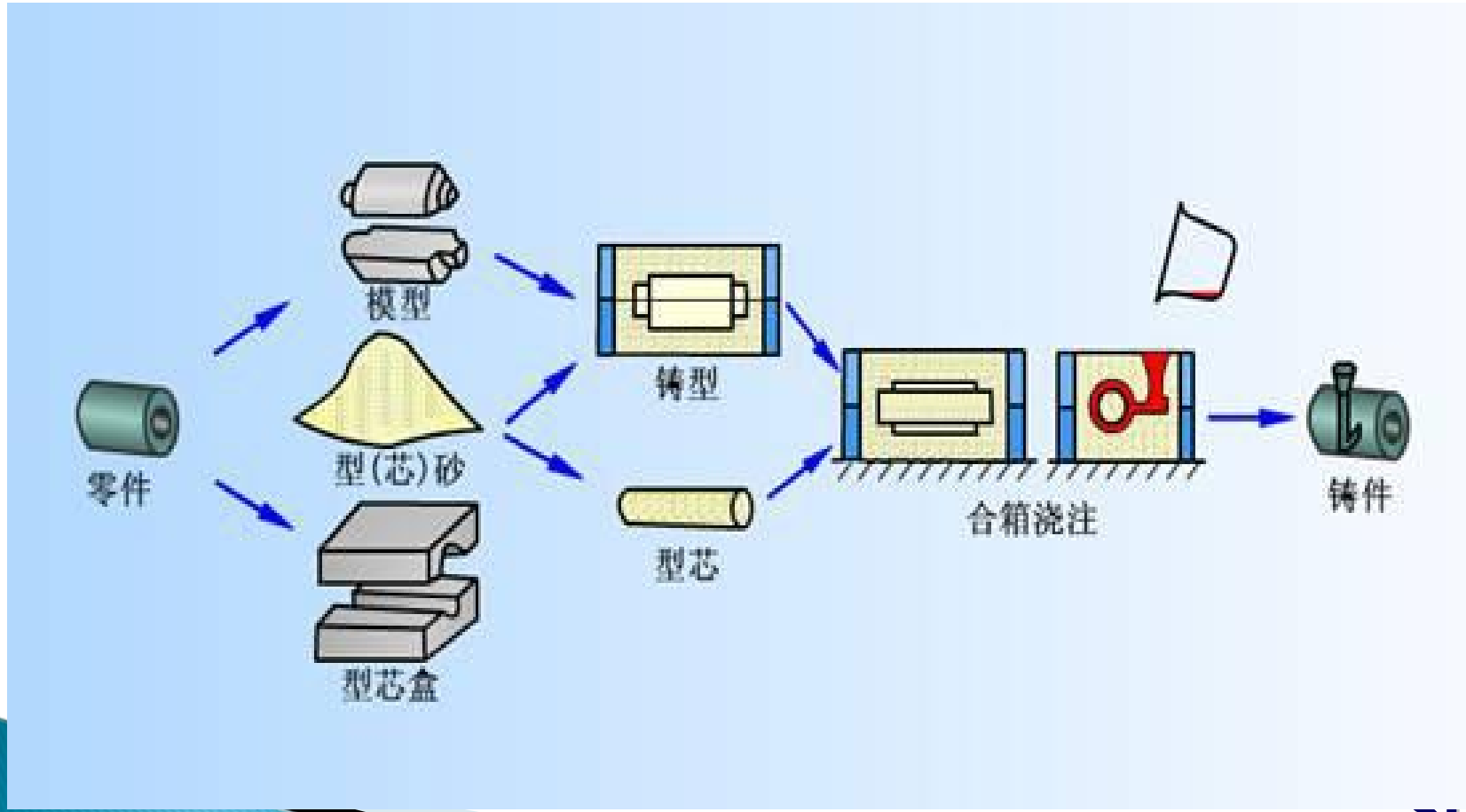
10.2 CASTING

- Sand casting
- Die casting
- Investment casting
- Lost foam casting
- Continuous casting

Structural metallic materials

10.2 CASTING

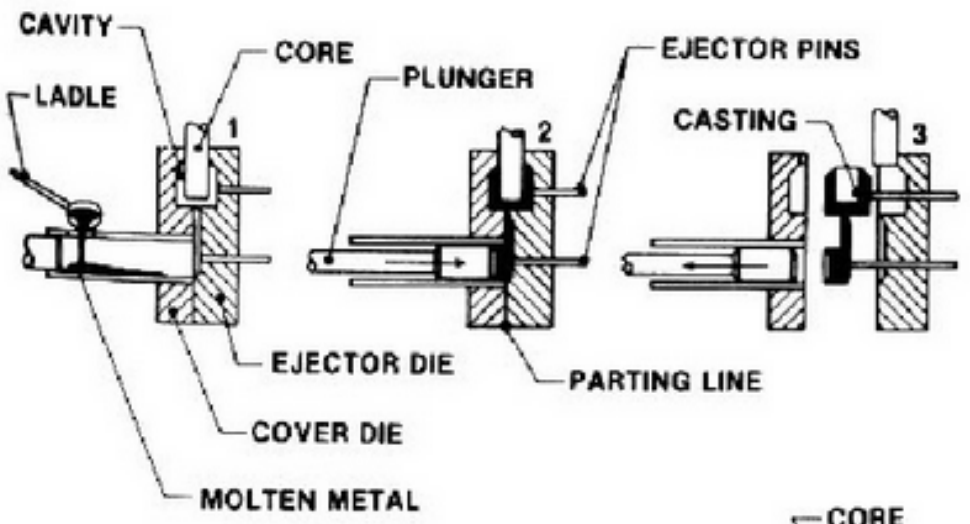
Sand casting



Structural metallic materials

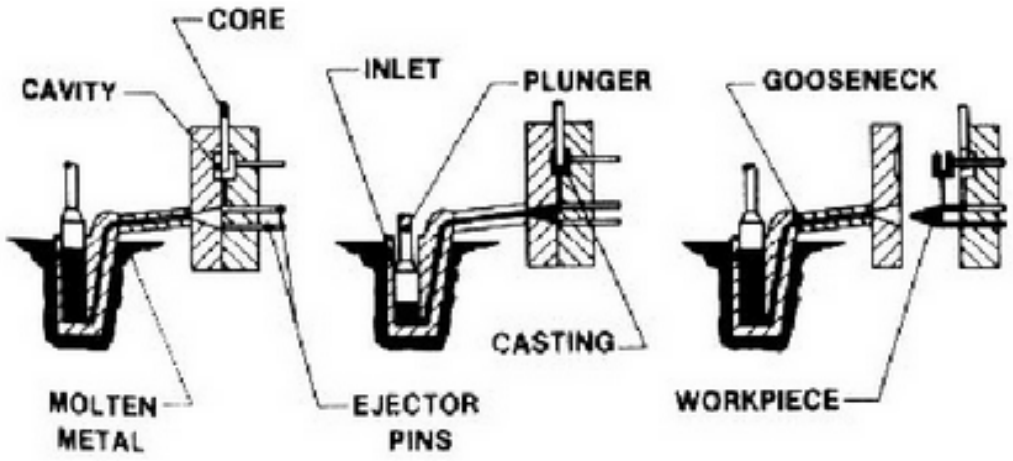
10.2 CASTING

Die Casting



Cold chamber

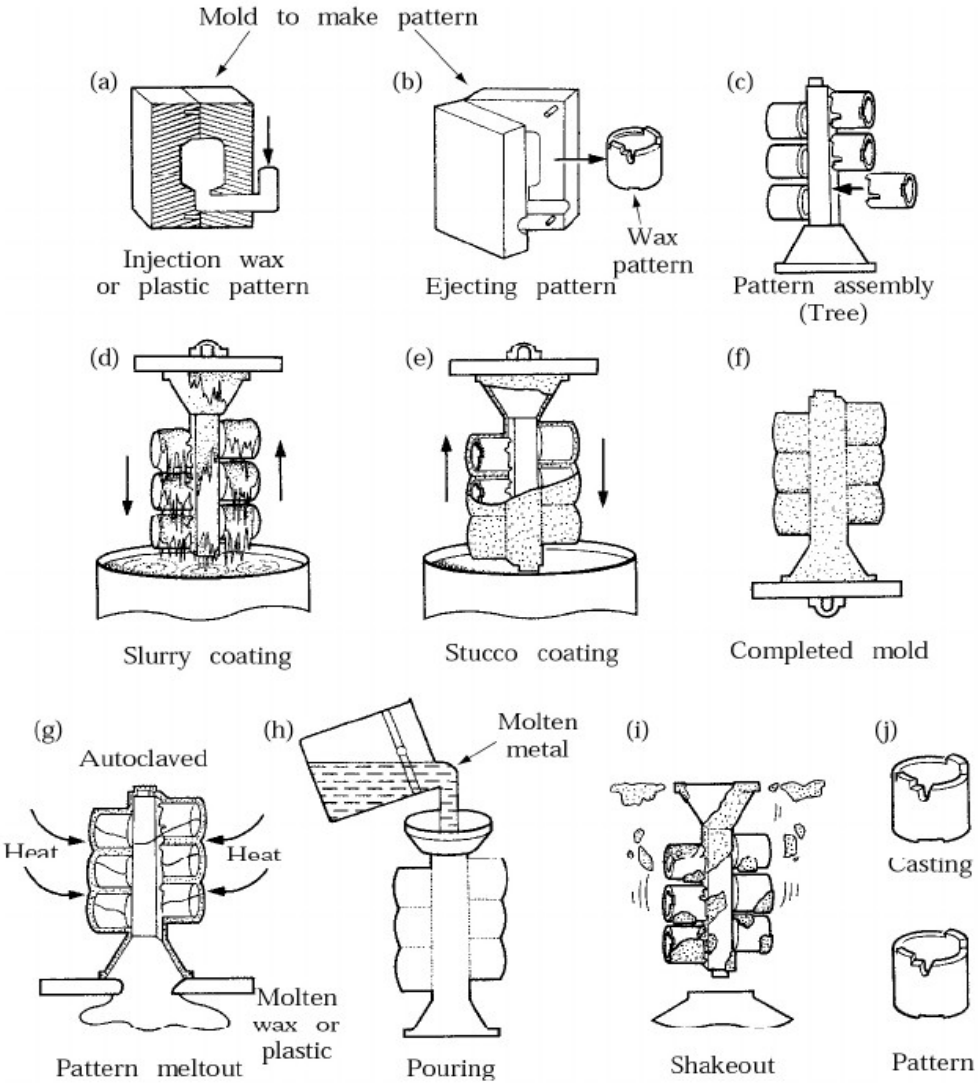
Hot chamber



Structural metallic materials

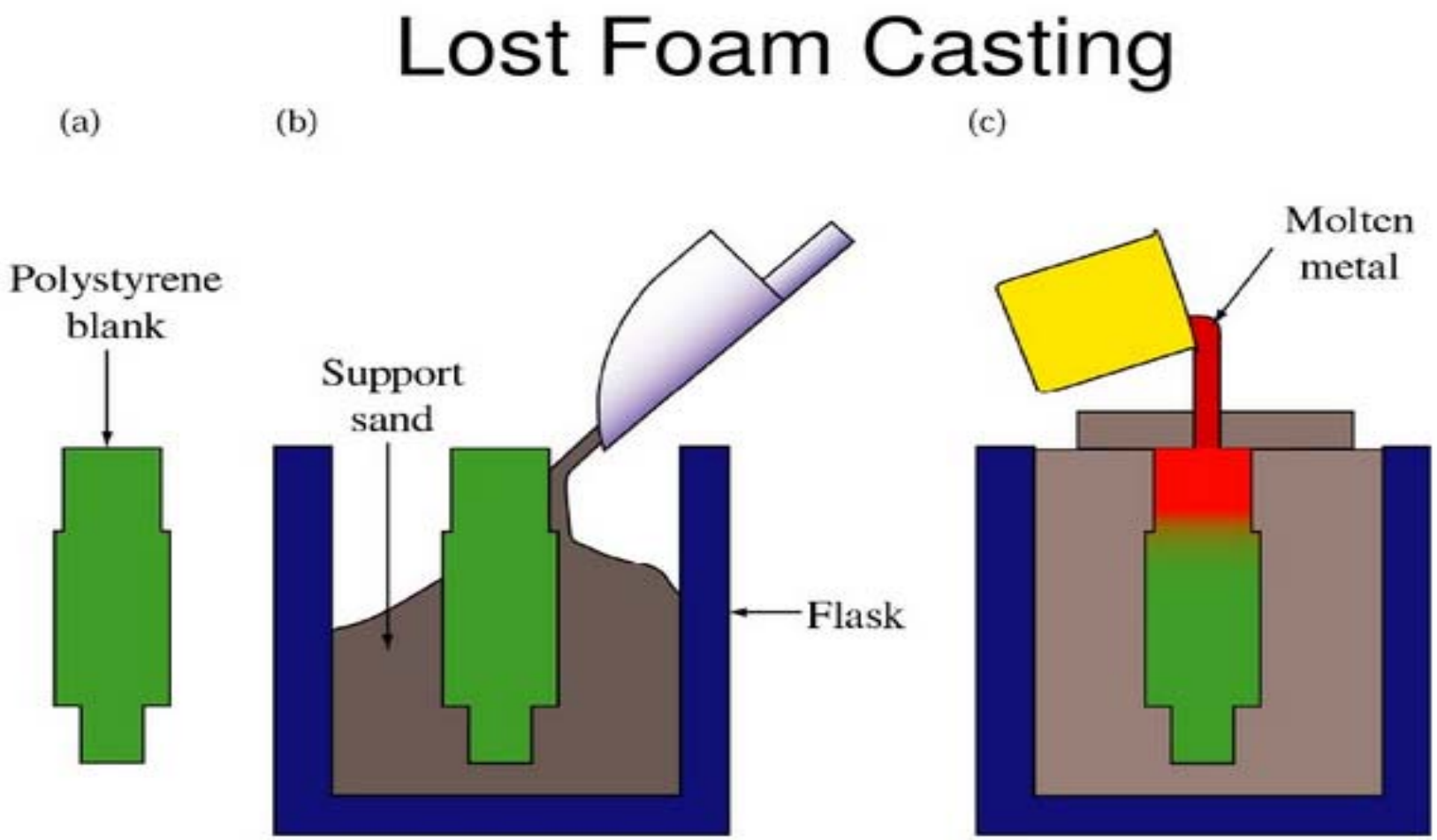
10.2 CASTING

Investment Casting



Structural metallic materials

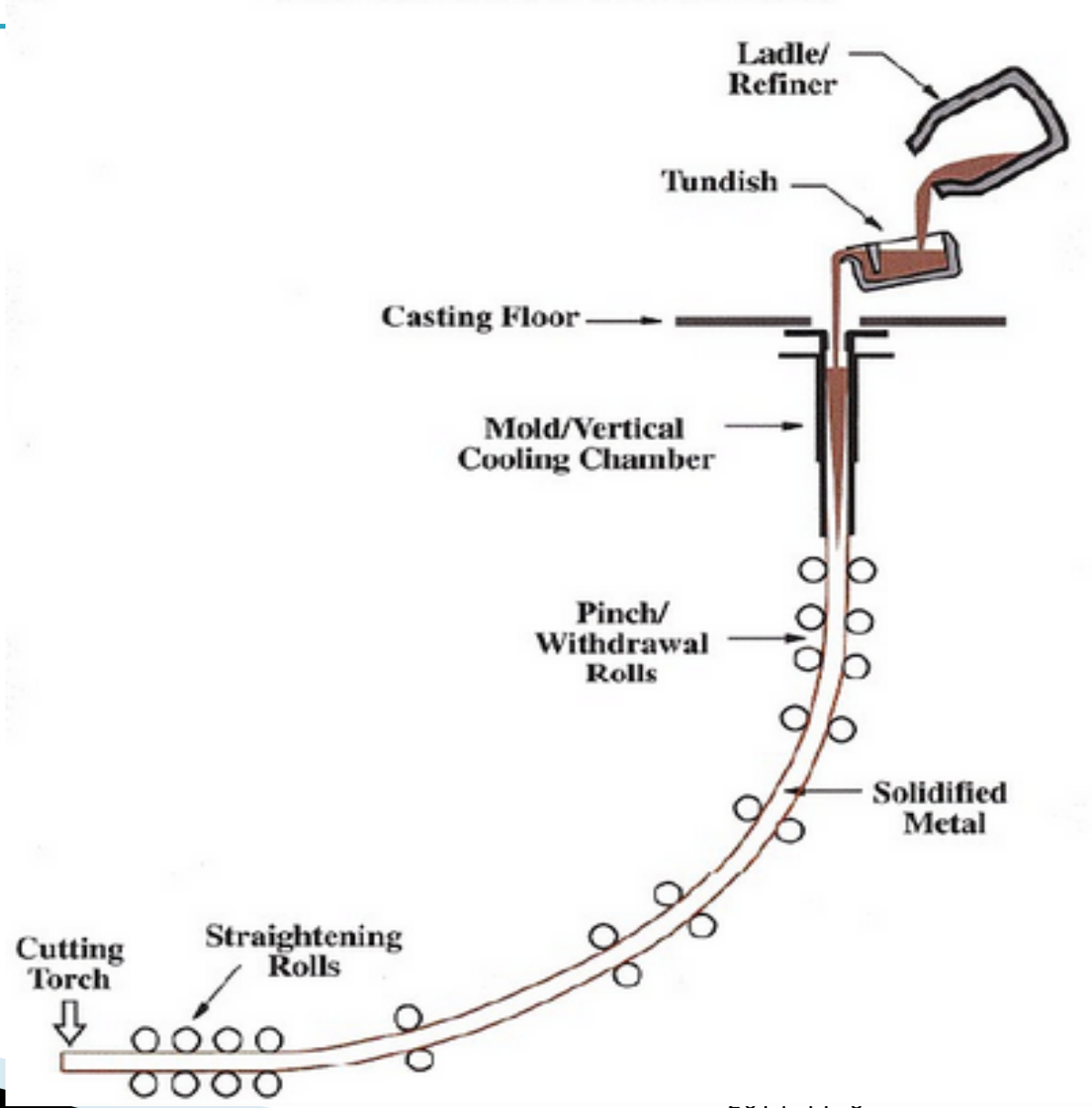
10.2 CASTING



Structural metallic materials

10.2 CASTING

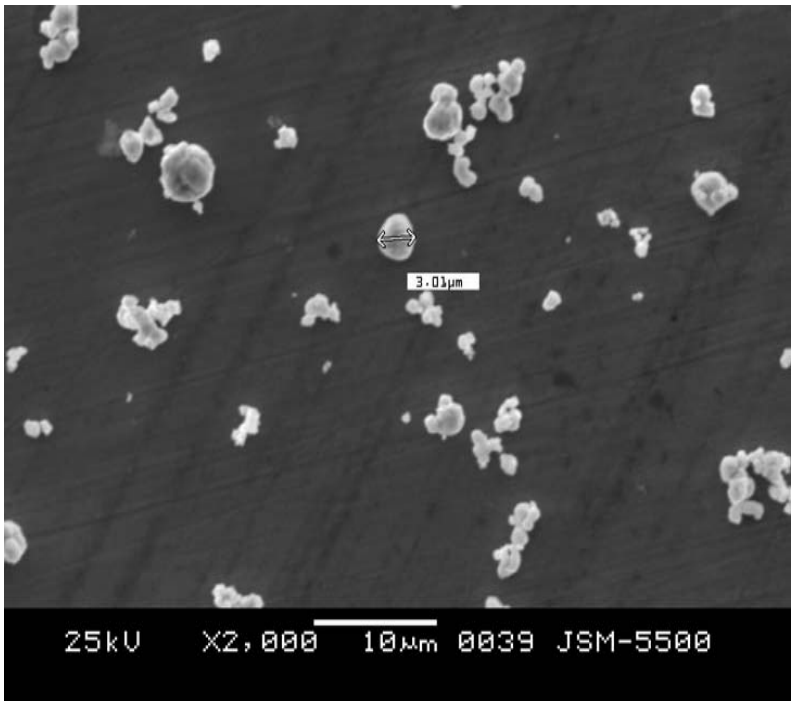
Continuous casting

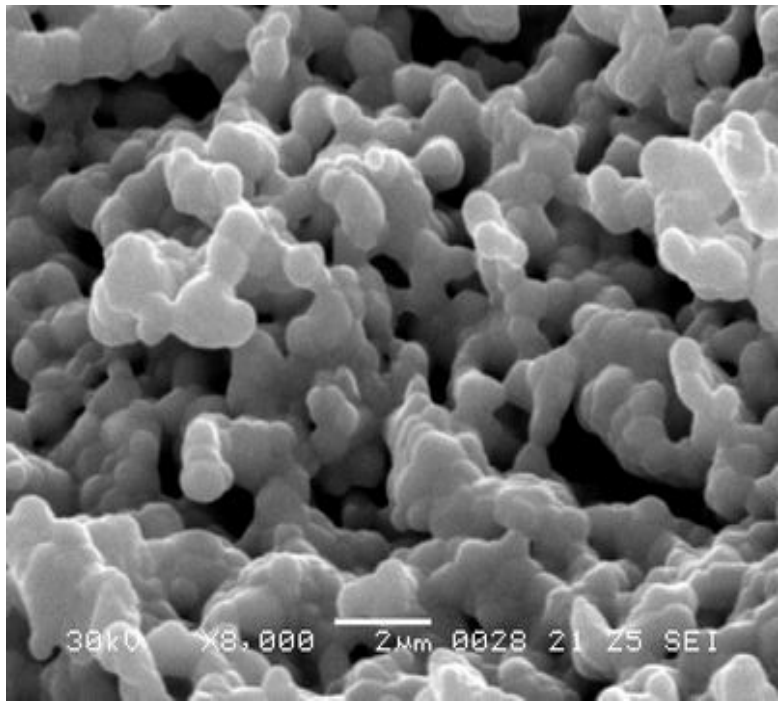


Structural metallic materials

10.3 MISCELLANEOUS TECHNIQUES

10.3.1 Powder metallurgy: the fabrication of metal pieces having intricate and precise shapes by the compaction of metal powders, followed By a densification heat treatment.





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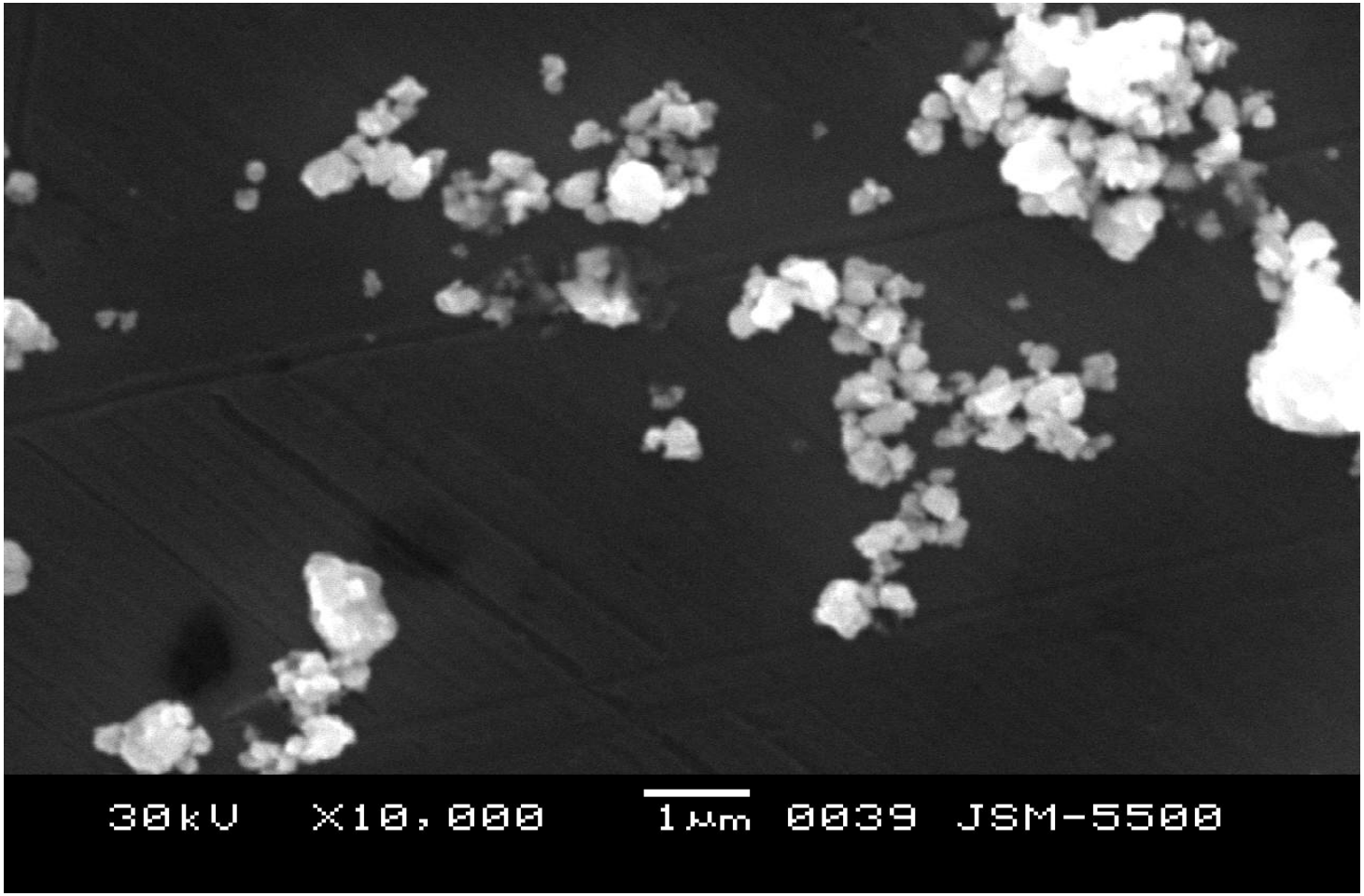
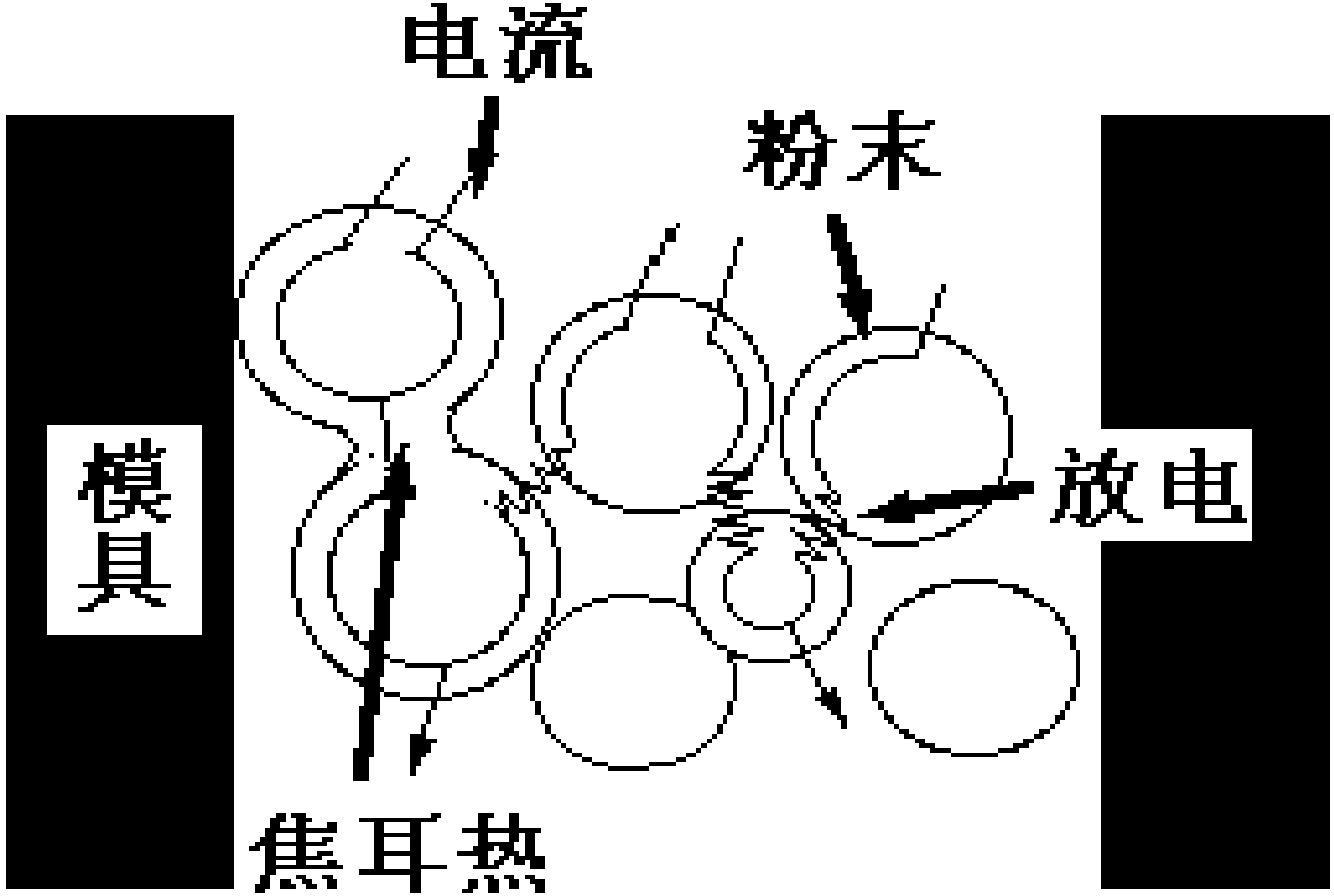
Structural metallic materials

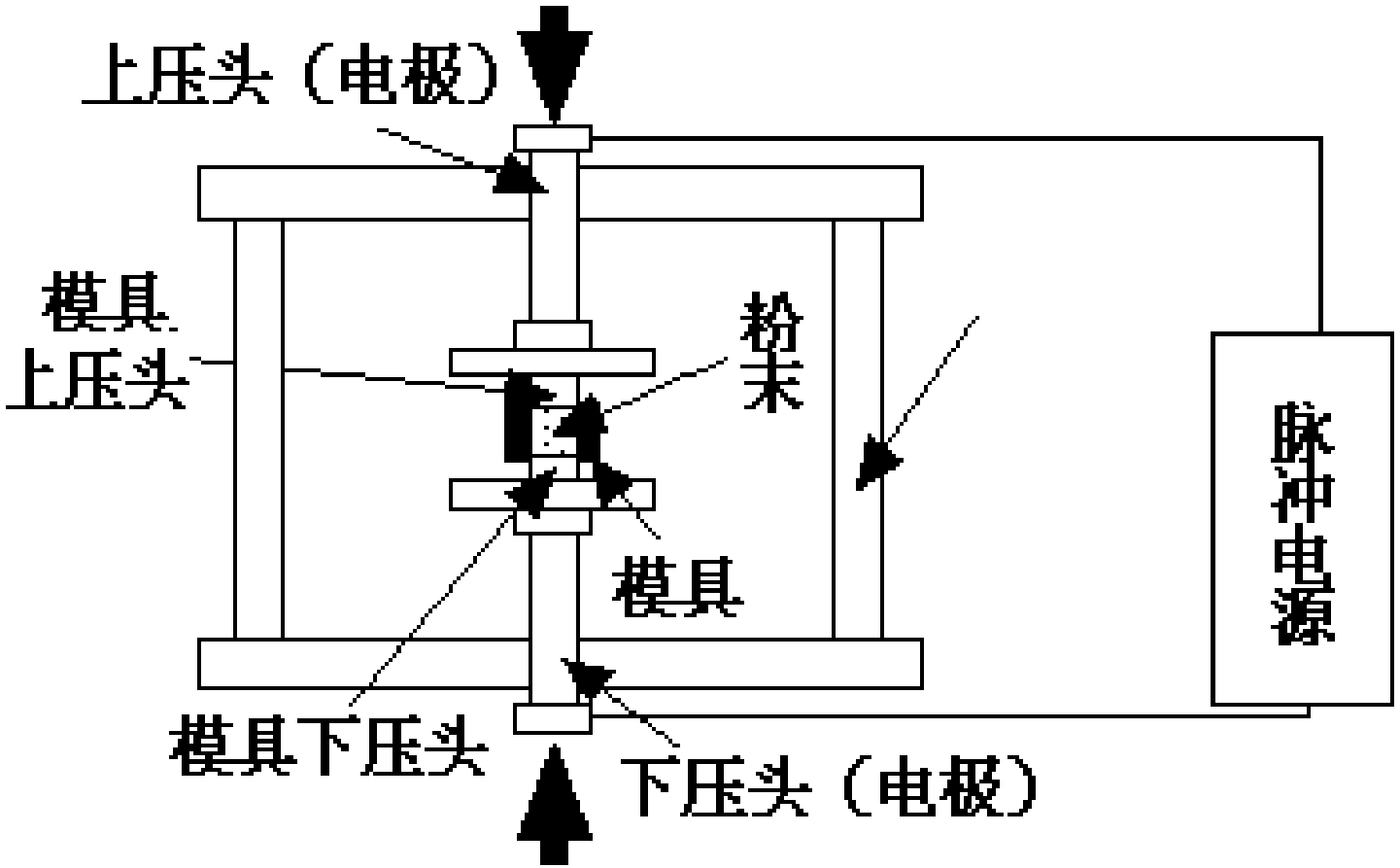


SIAE

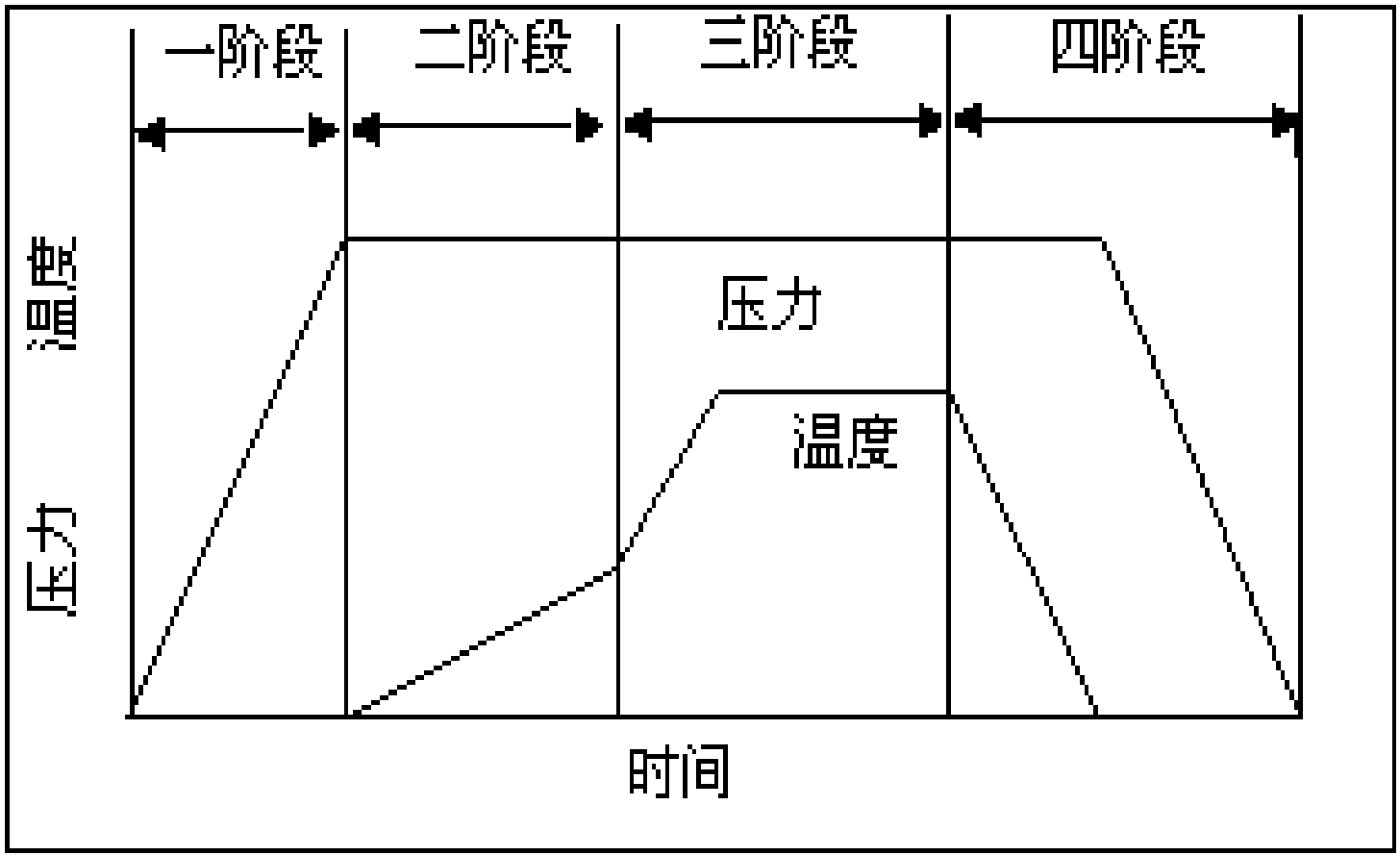
Structural metallic materials



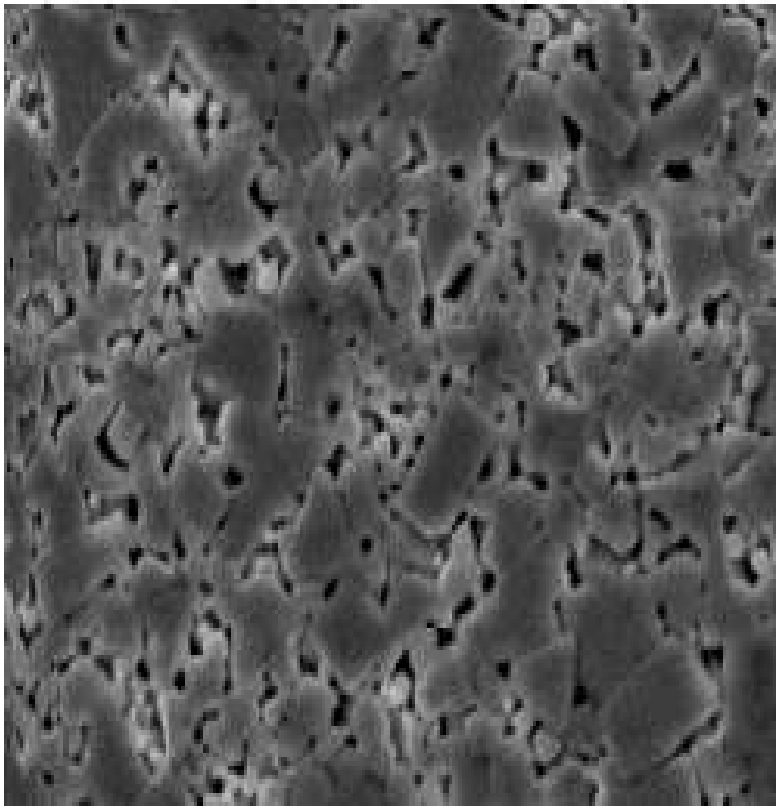
Structural metallic materials

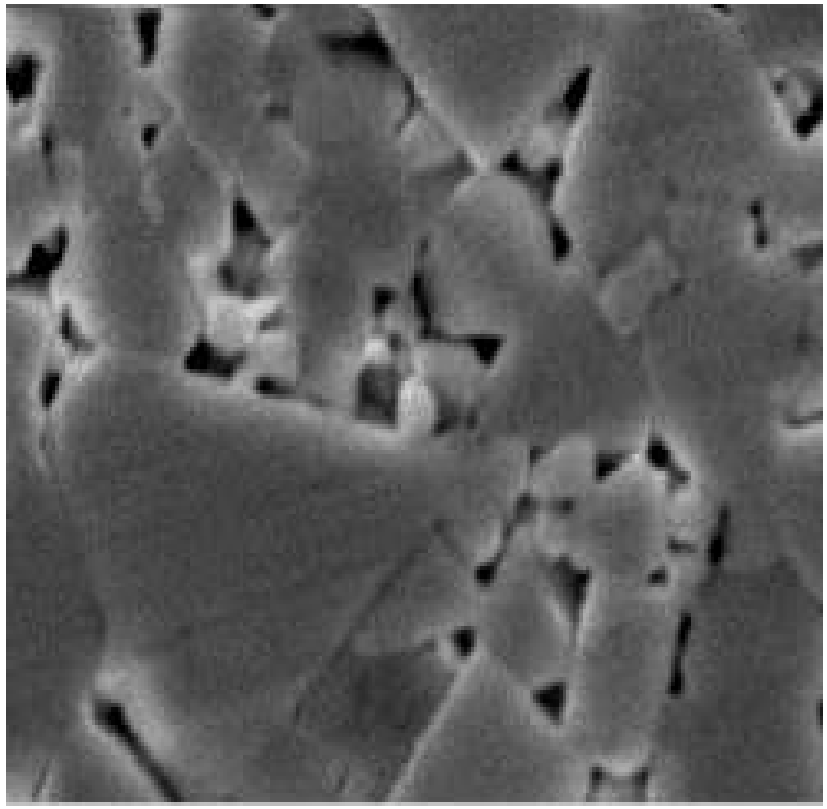


Structural metallic materials



Structural metallic materials

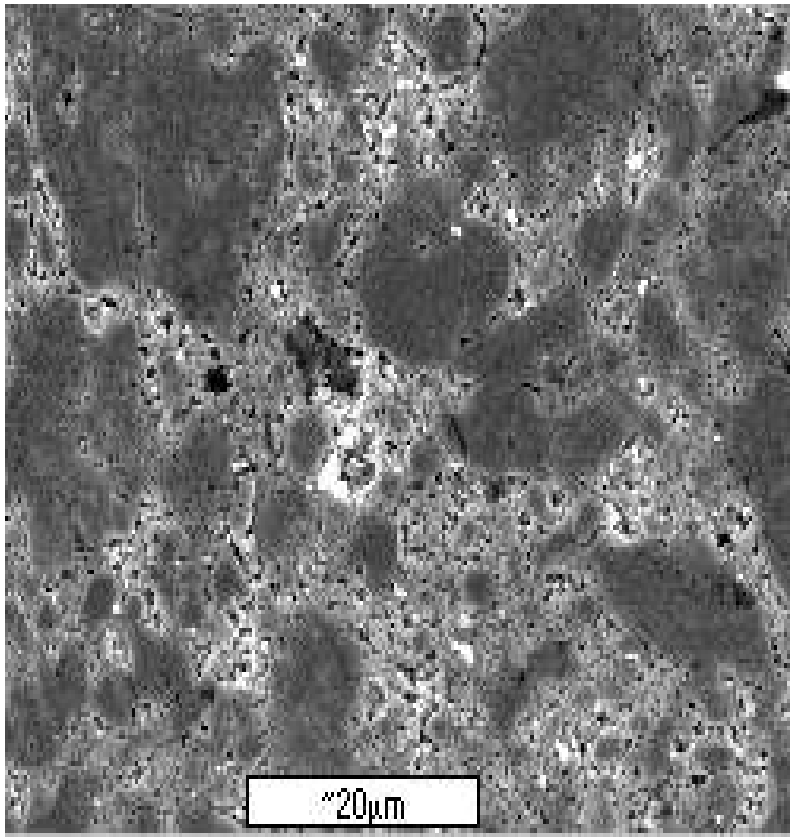


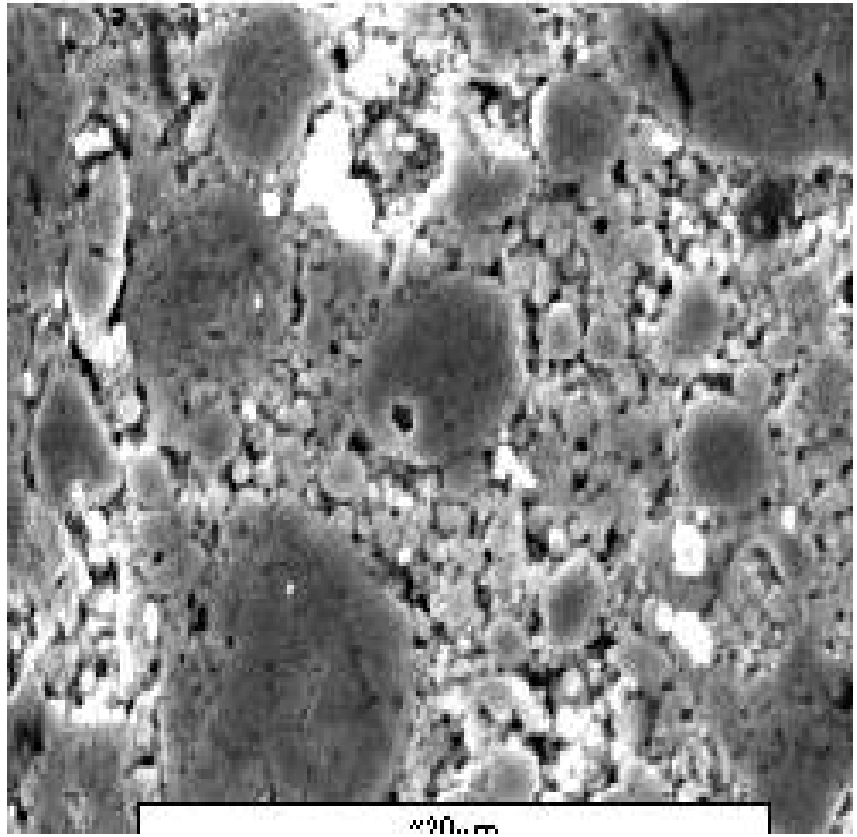


YG6 SEM

Structural metallic materials

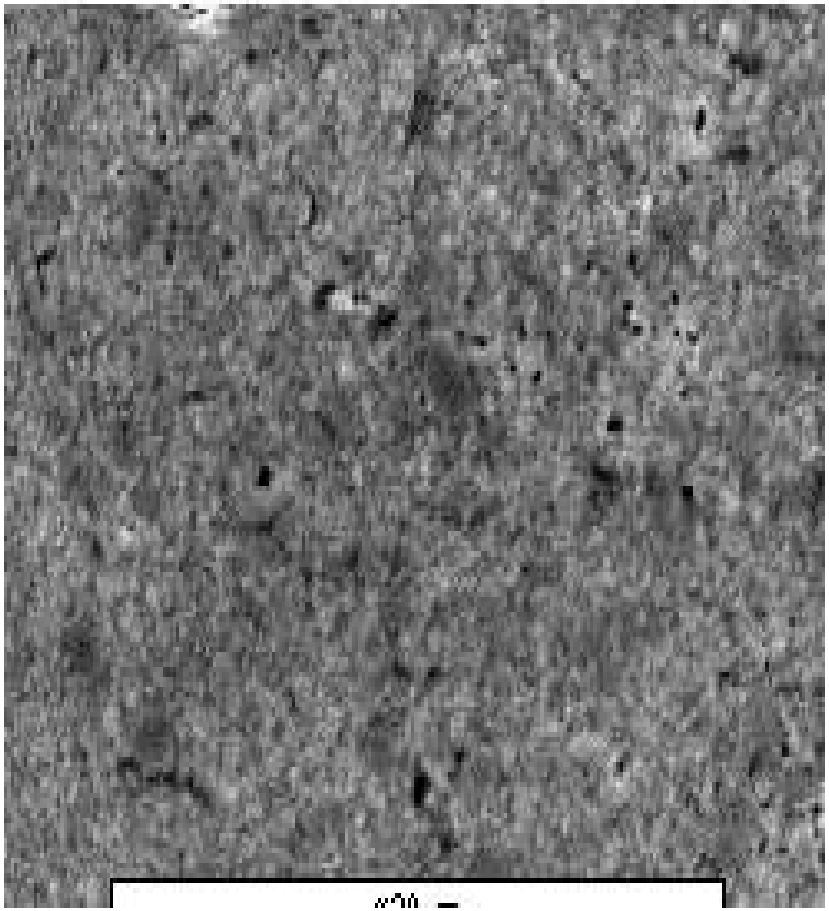
1100℃/3'

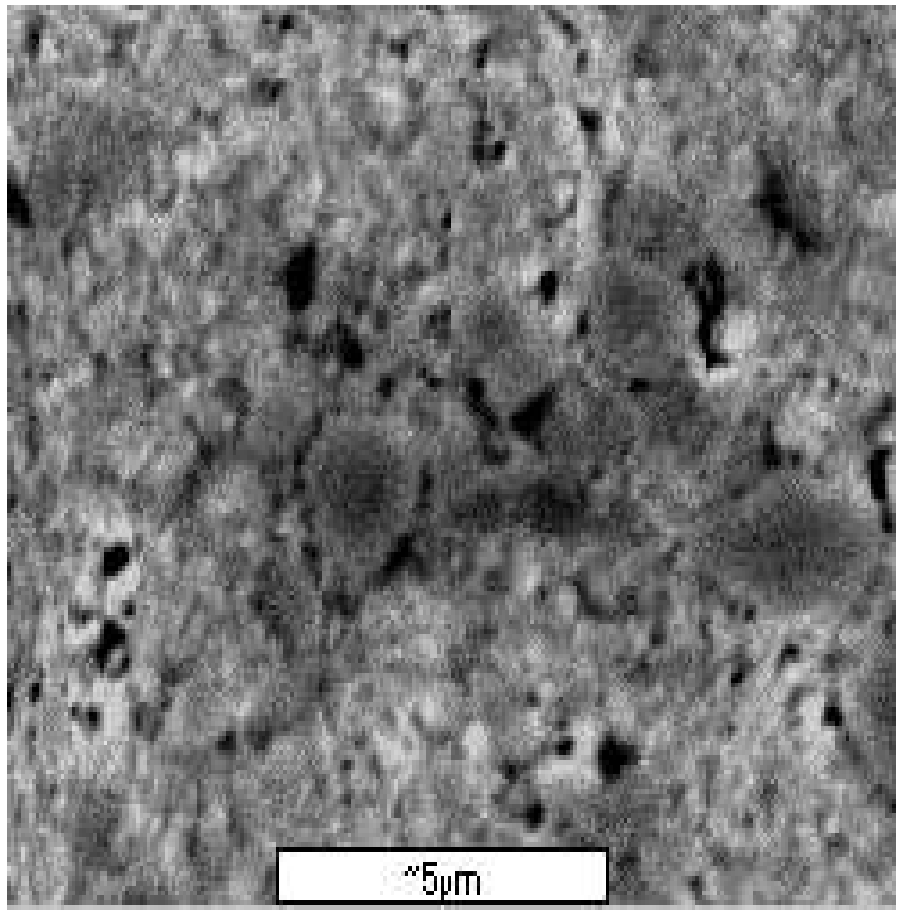




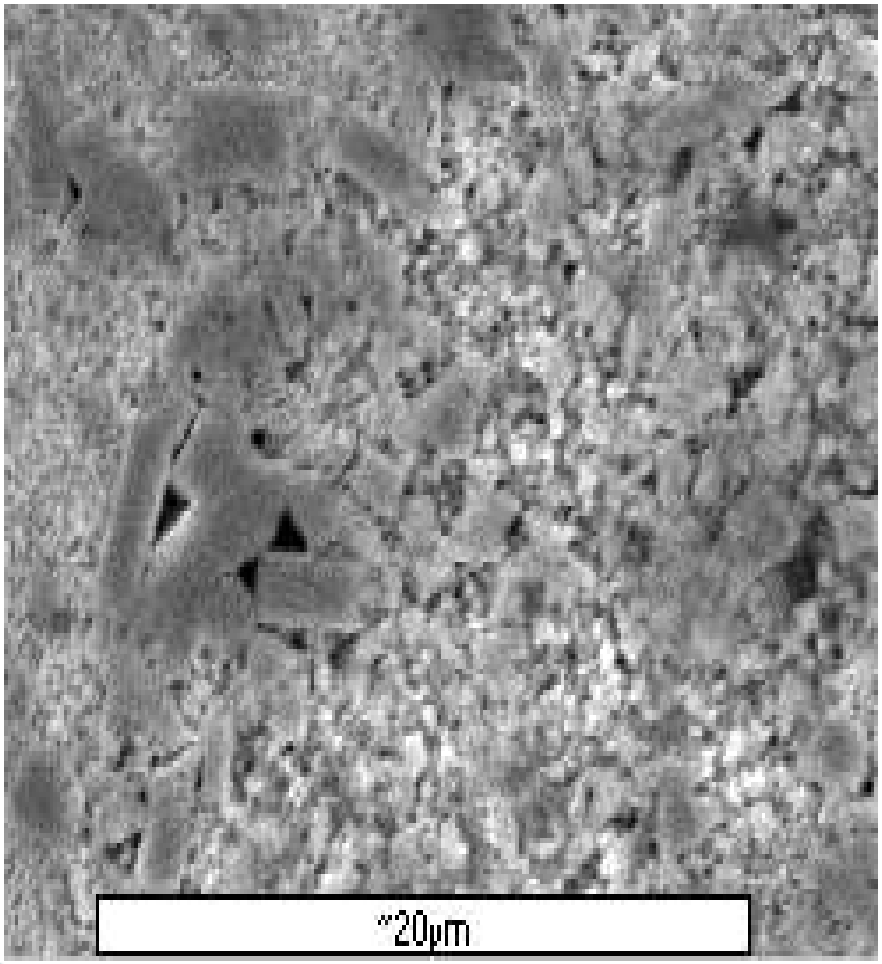
SIAE

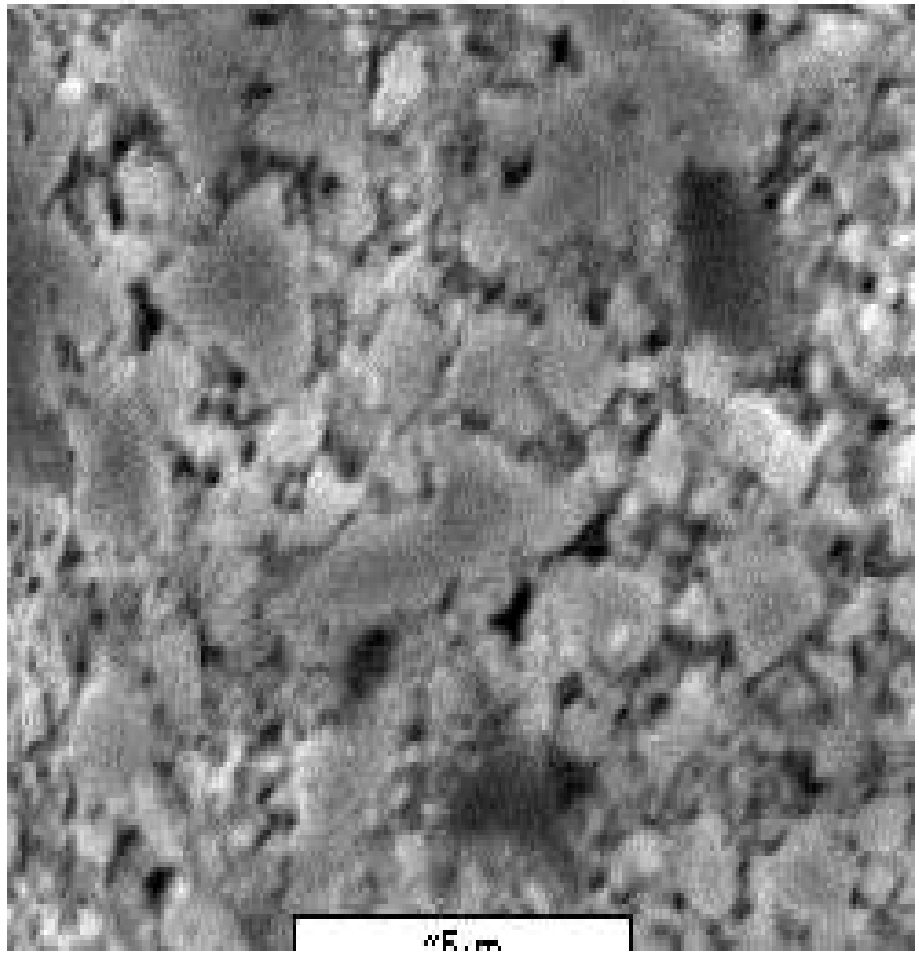
1200℃/3'



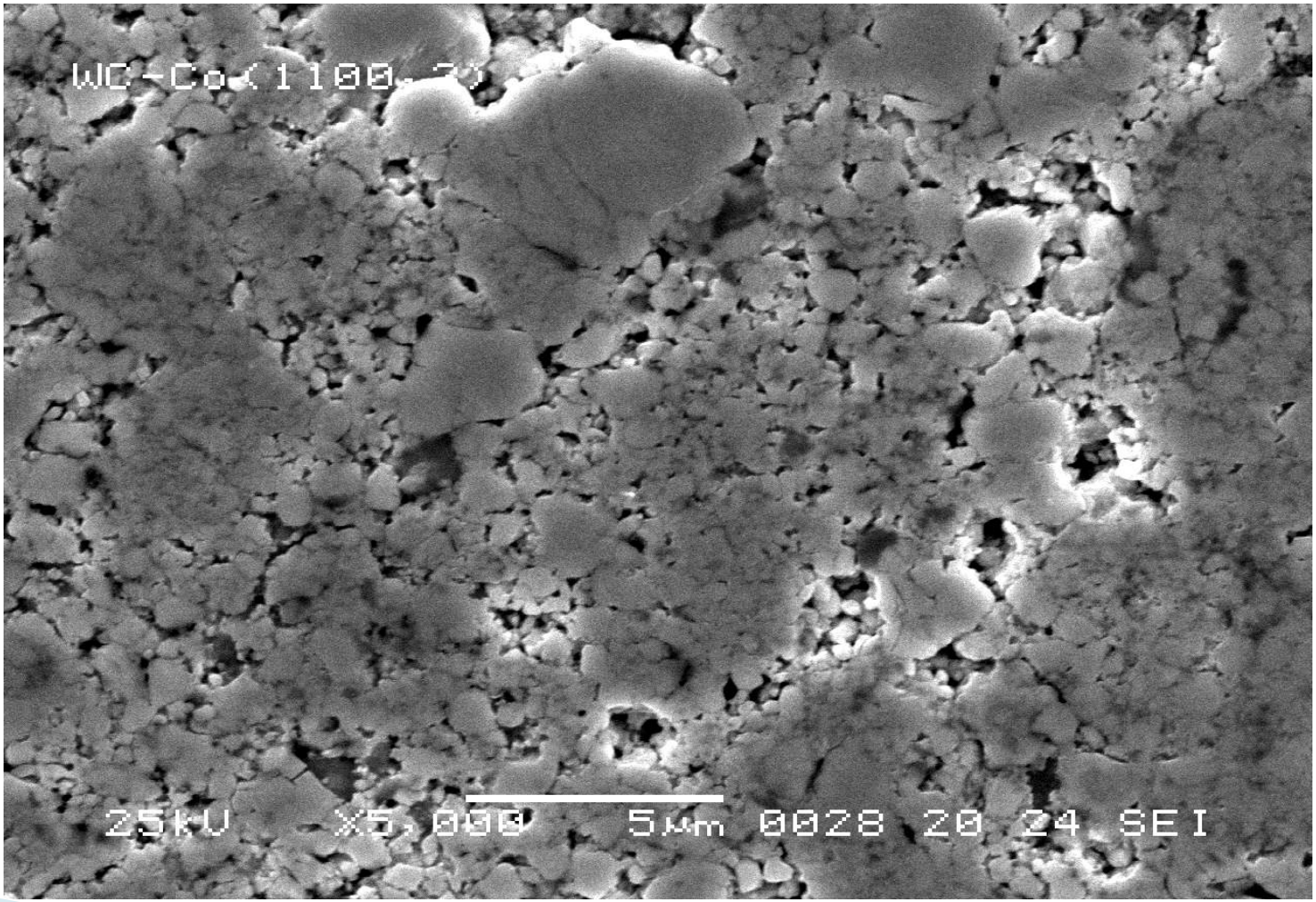


1300℃/1'

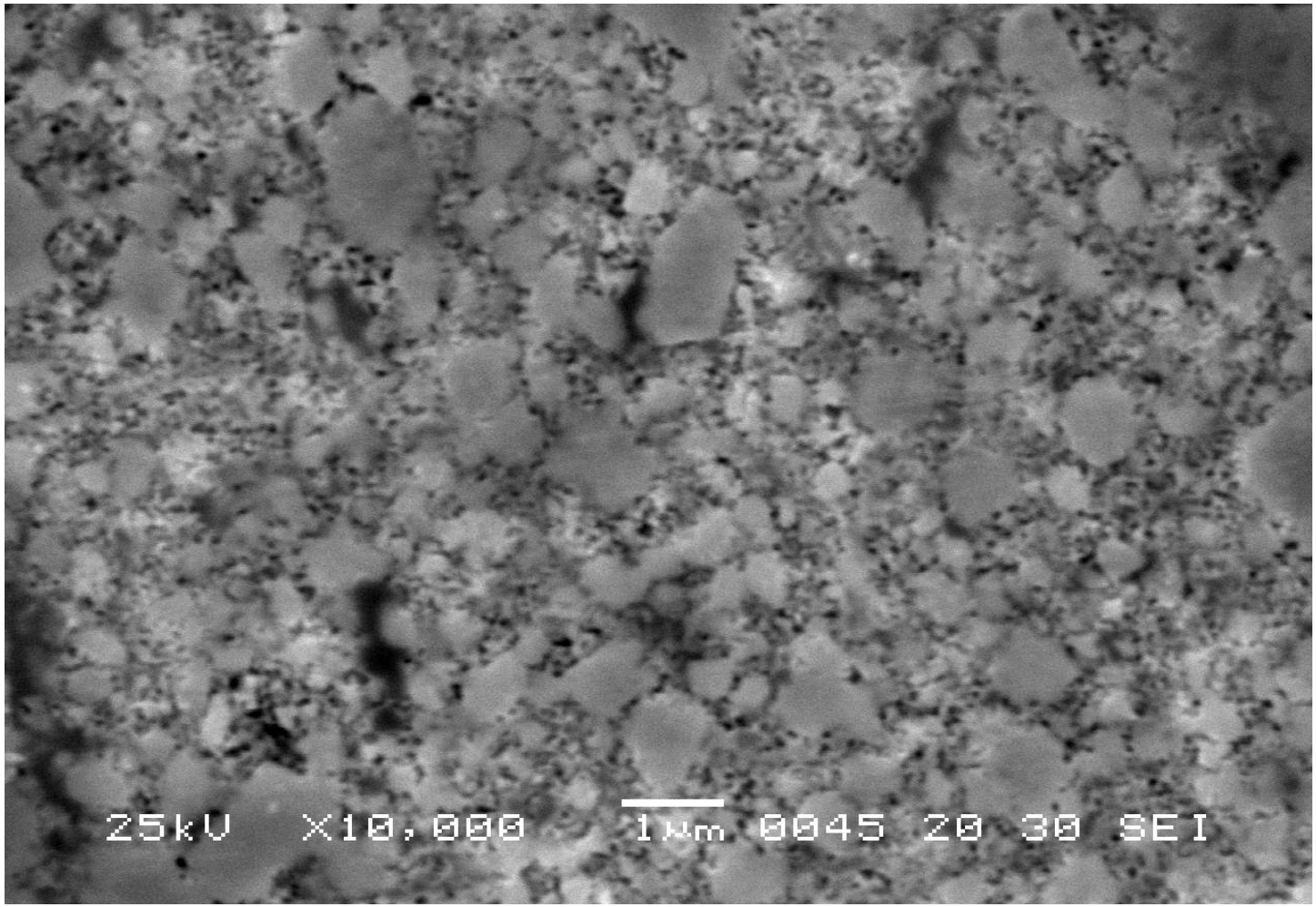




1100℃/3'



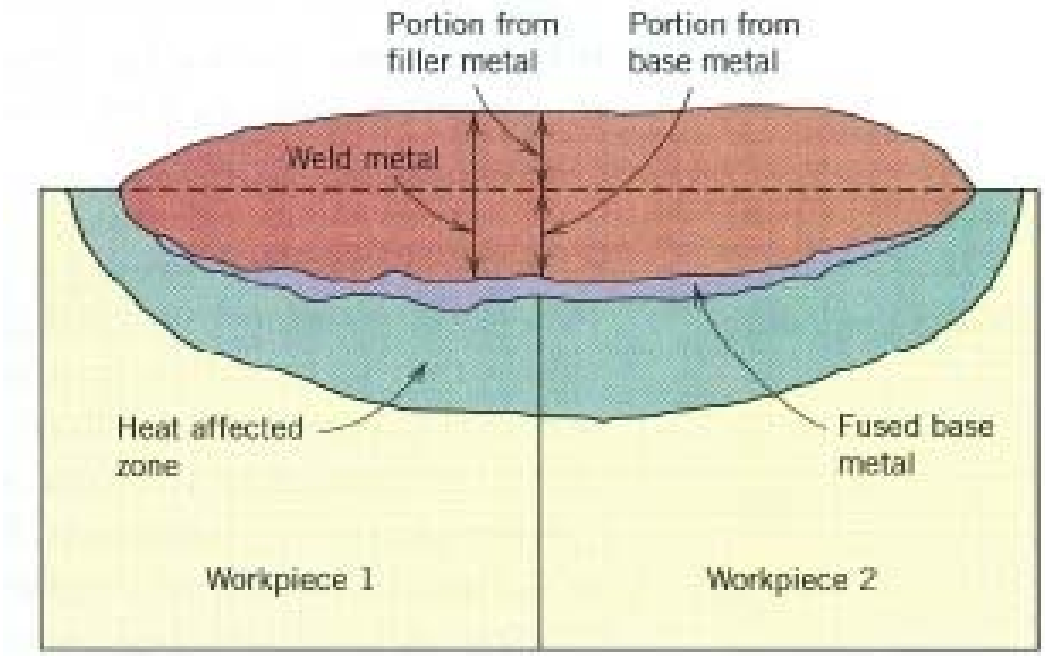
1200℃/3'



Structural metallic materials

10.3MISCELLANEOUS TECHNIQUES

10.3.2 Welding: a technique for joining metals in which actual melting of the pieces to be joined occurs in the vicinity of the bond. A filler metal may be used to facilitate the process



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Structural metallic materials

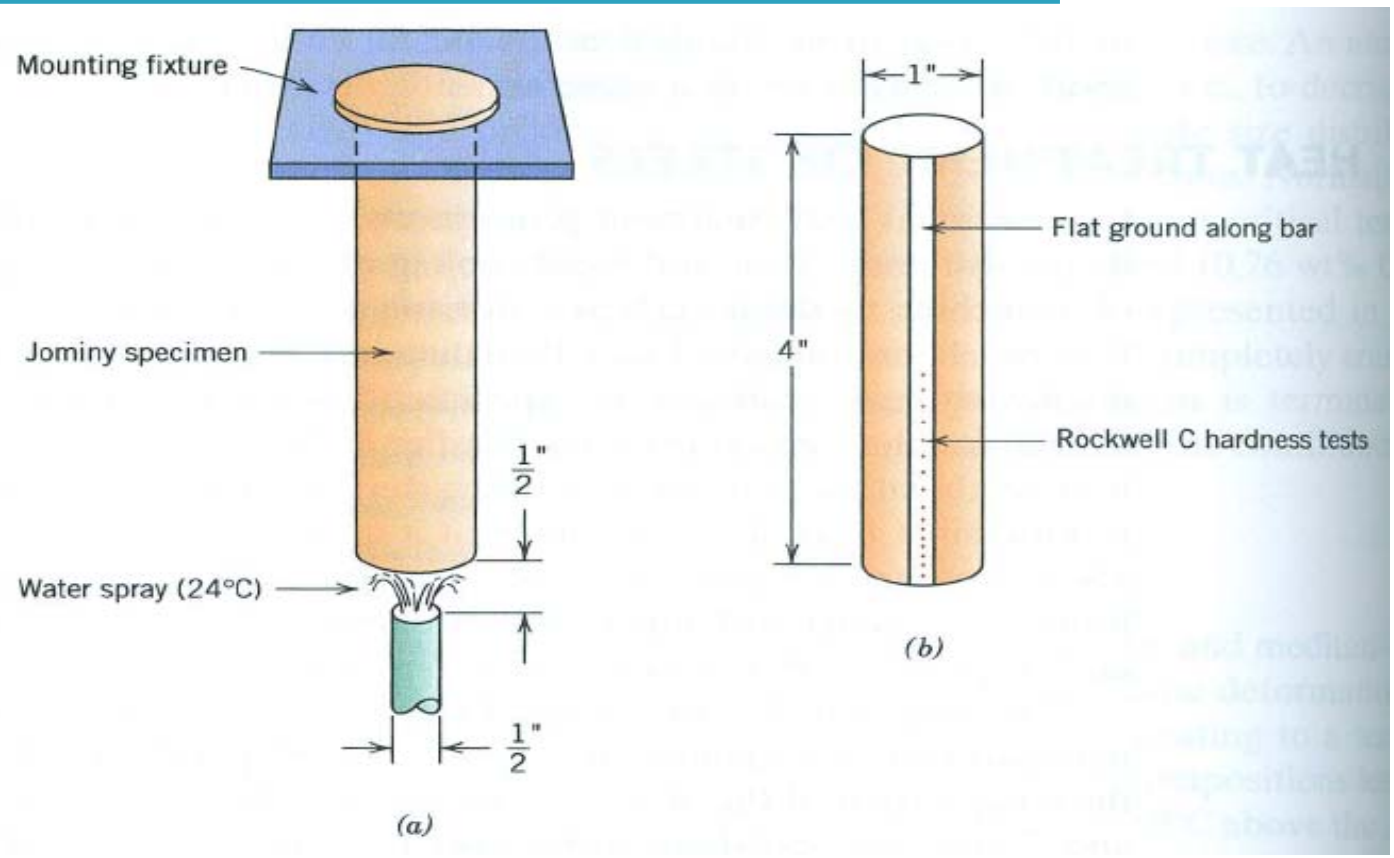
10.4 HEAT TREATMENT OF STEELS

hardenability: a measure of the depth to which a specific ferrous alloy may be hardened by the formation of martensite upon quenching from a temperature above the upper critical temperature.

Jominy end-quench test: a standardized laboratory test that is used to assess the hardenability of ferrous alloys

Structural metallic materials

10.4 HEAT TREATMENT OF STEELS



(a) Mouted during quenching
(b) after hardness testing from the quenched end along a ground flat

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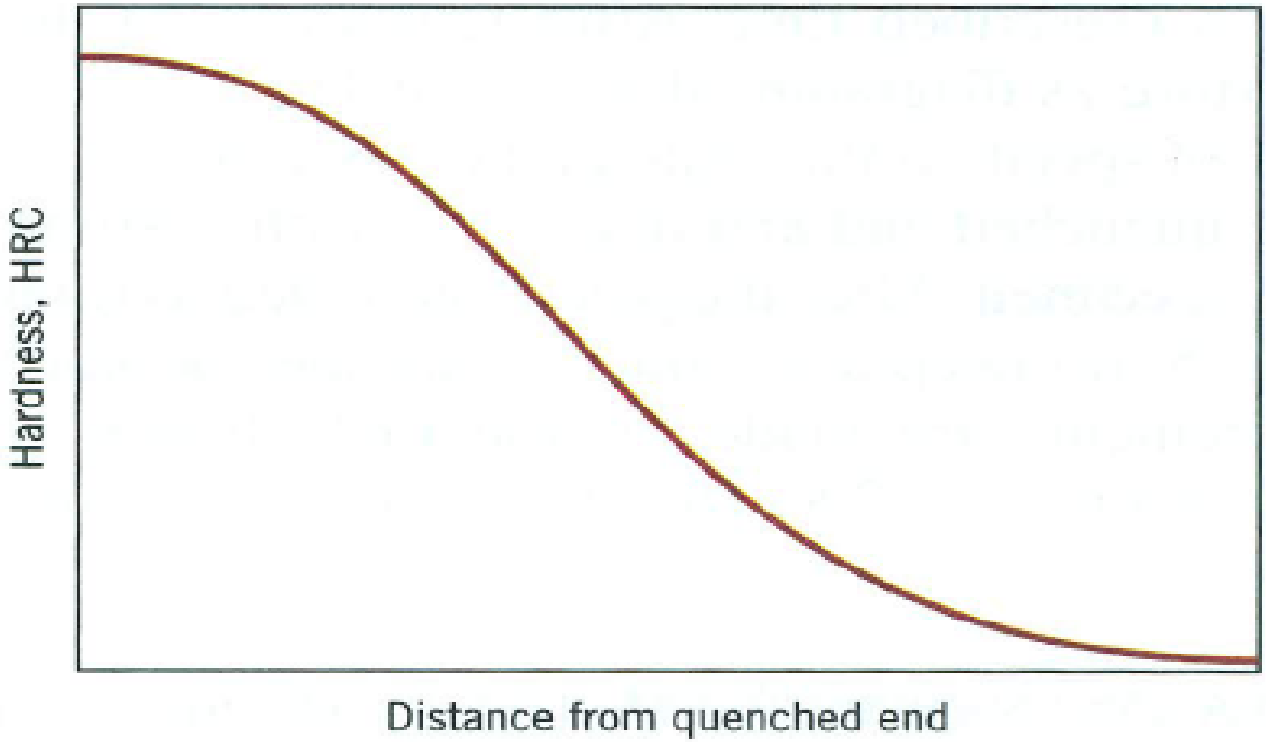
Structural metallic materials

10.4 HEAT TREATMENT OF STEELS

Hardenability Curves



Typical hardenability plot of Rockwell C hardness as a function of distance from the quenched end

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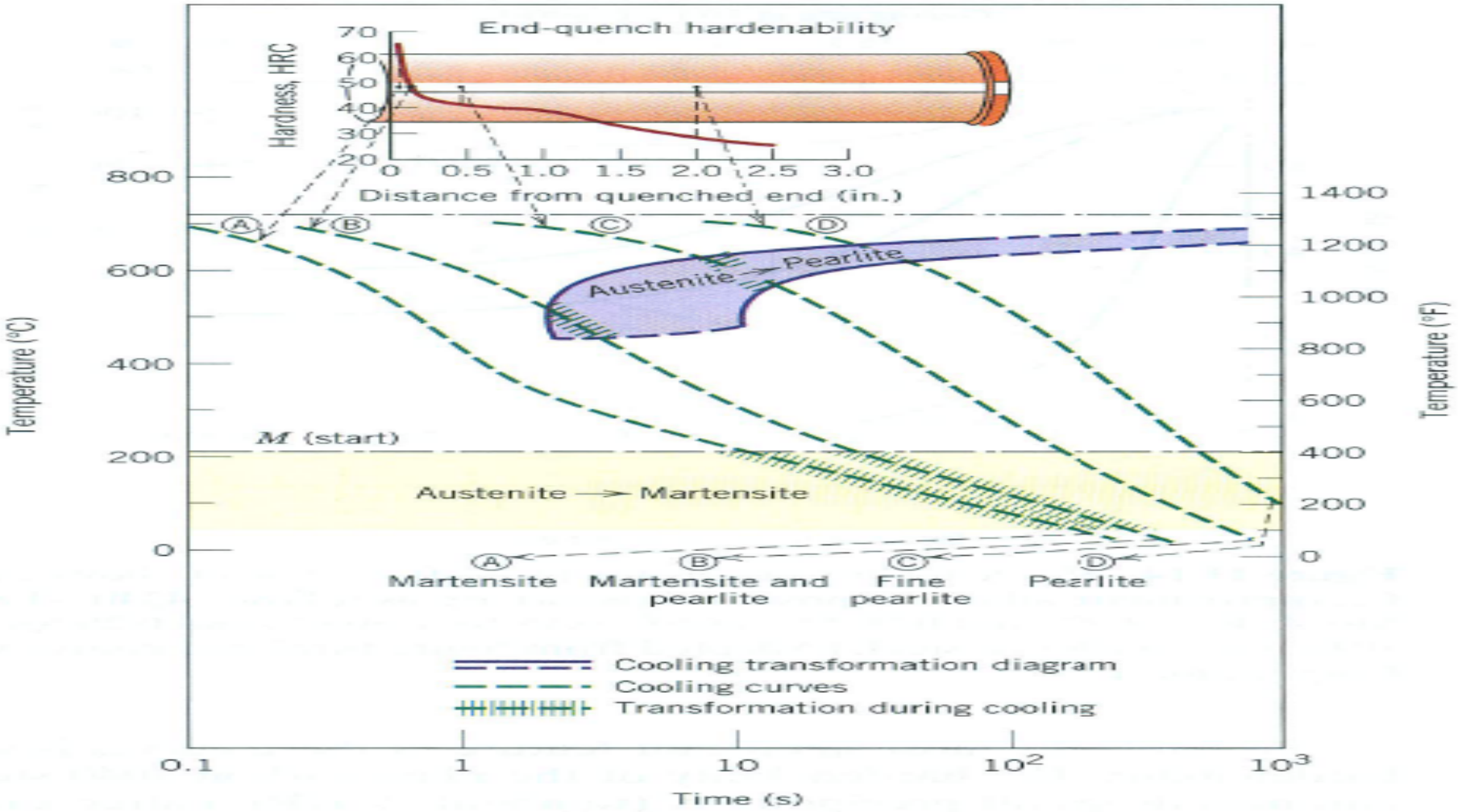
Structural metallic materials

10.4 HEAT TREATMENT OF STEELS



Correlation of hardenability and continuous cooling information cooling information for an iron-carbon alloy of eutectoid composition

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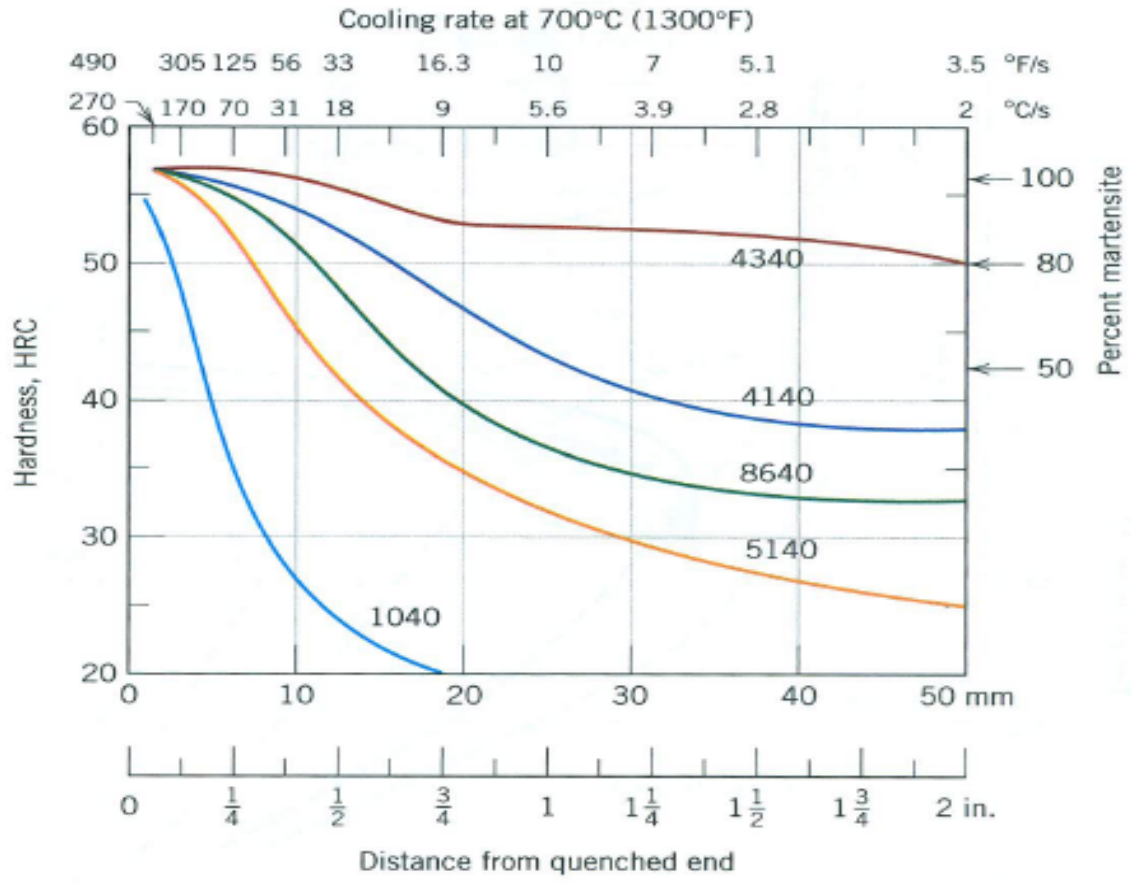
Structural metallic materials

10.4 HEAT TREATMENT OF STEELS



Hardenability curves for five different steel alloys

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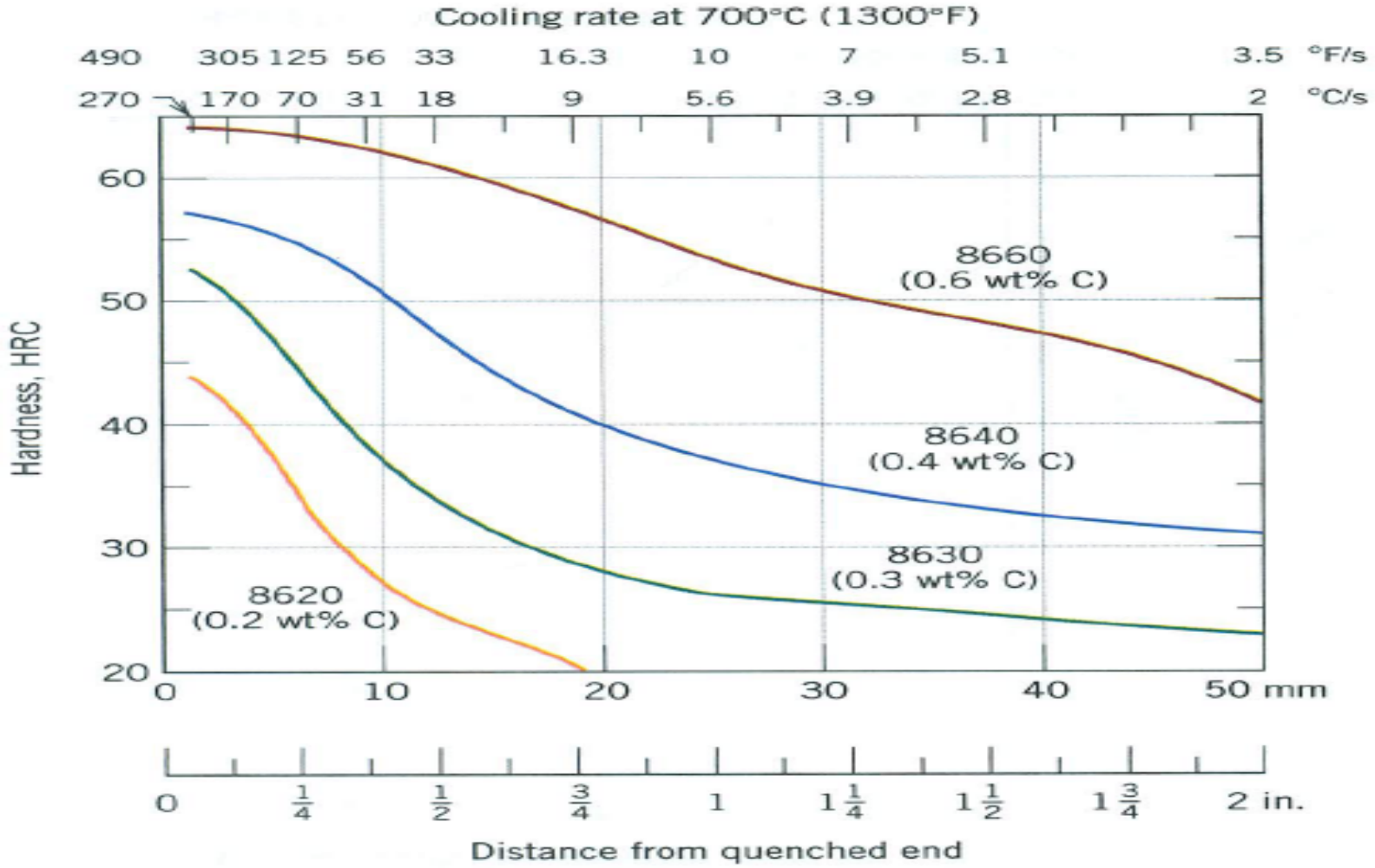
Structural metallic materials

10.4 HEAT TREATMENT OF STEELS

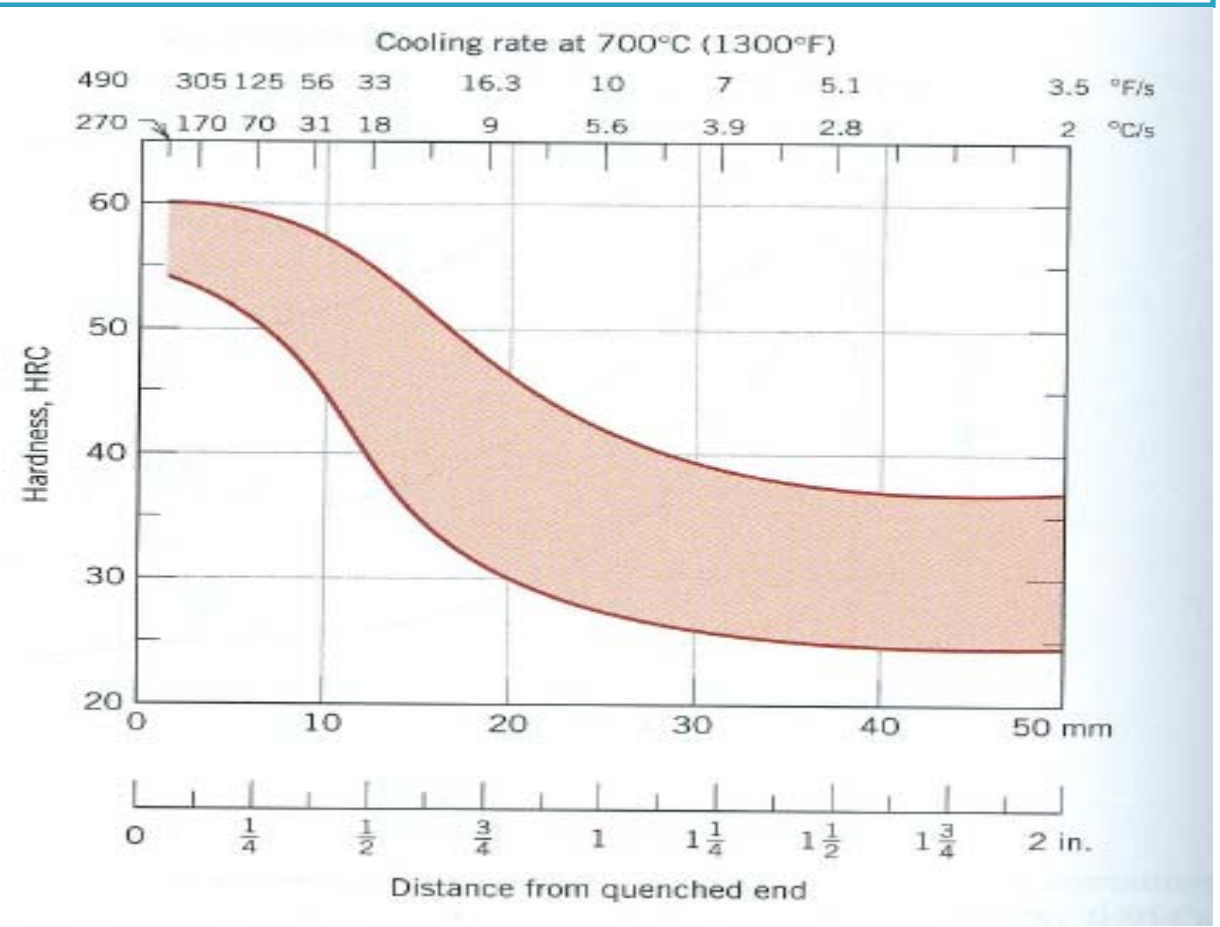


Hardenability curves for four 8600 series alloys of indicated carbon content

SIAE

Structural metallic materials

10.4 HEAT TREATMENT OF STEELS

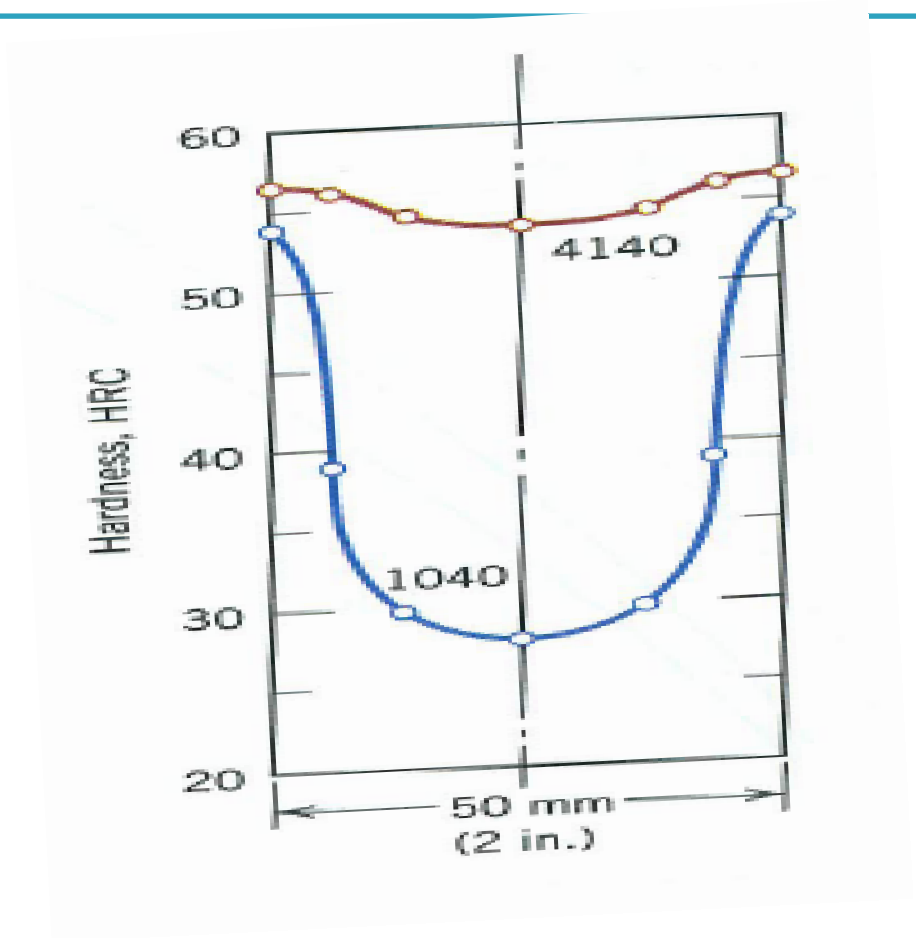


The hardenability band for an 8640 steel indicating maximum and minimum limits

SIAE

Structural metallic materials

10.4 HEAT TREATMENT OF STEELS

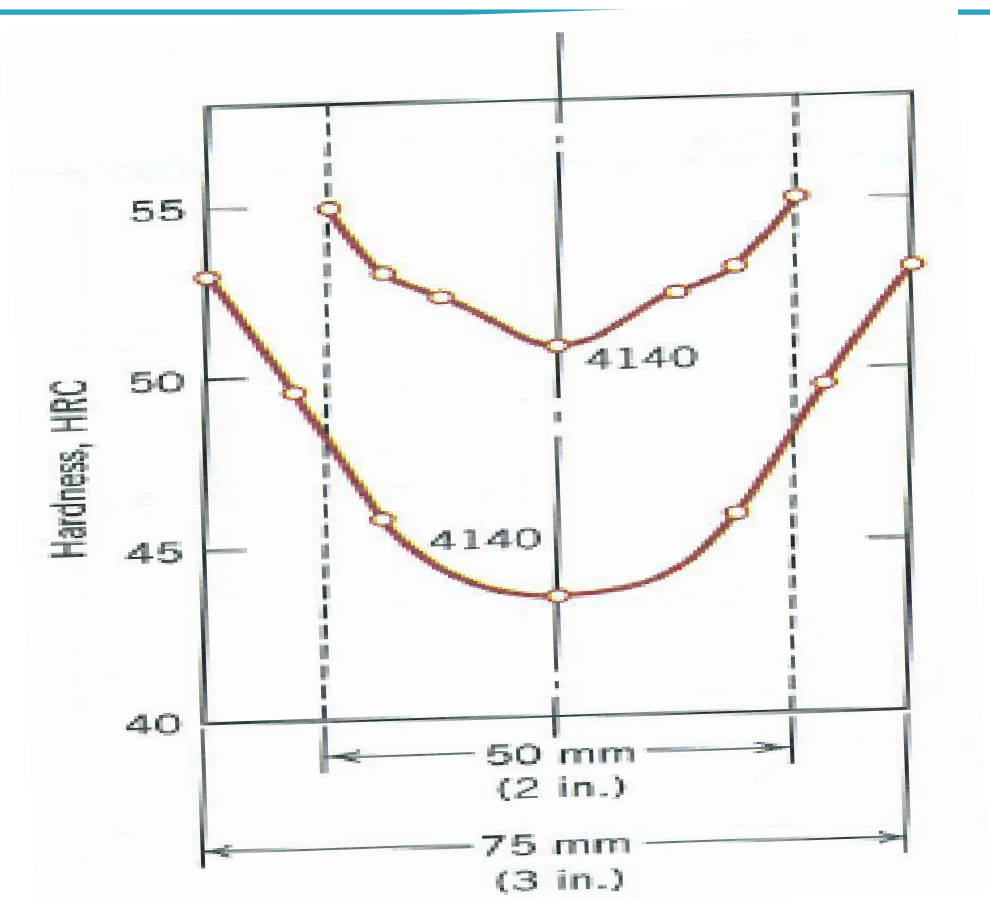


Radial hardness profiles for (a)50-mm-diameter cylindrical 1040 and 4140 steel specimens quenched in mildly agitated water

SIAE

Structural metallic materials

10.4 HEAT TREATMENT OF STEELS



Radial hardness profiles for (a)50-and 75-mm-diameter cylindrical 4140 steel quenched in mildly agitated oil

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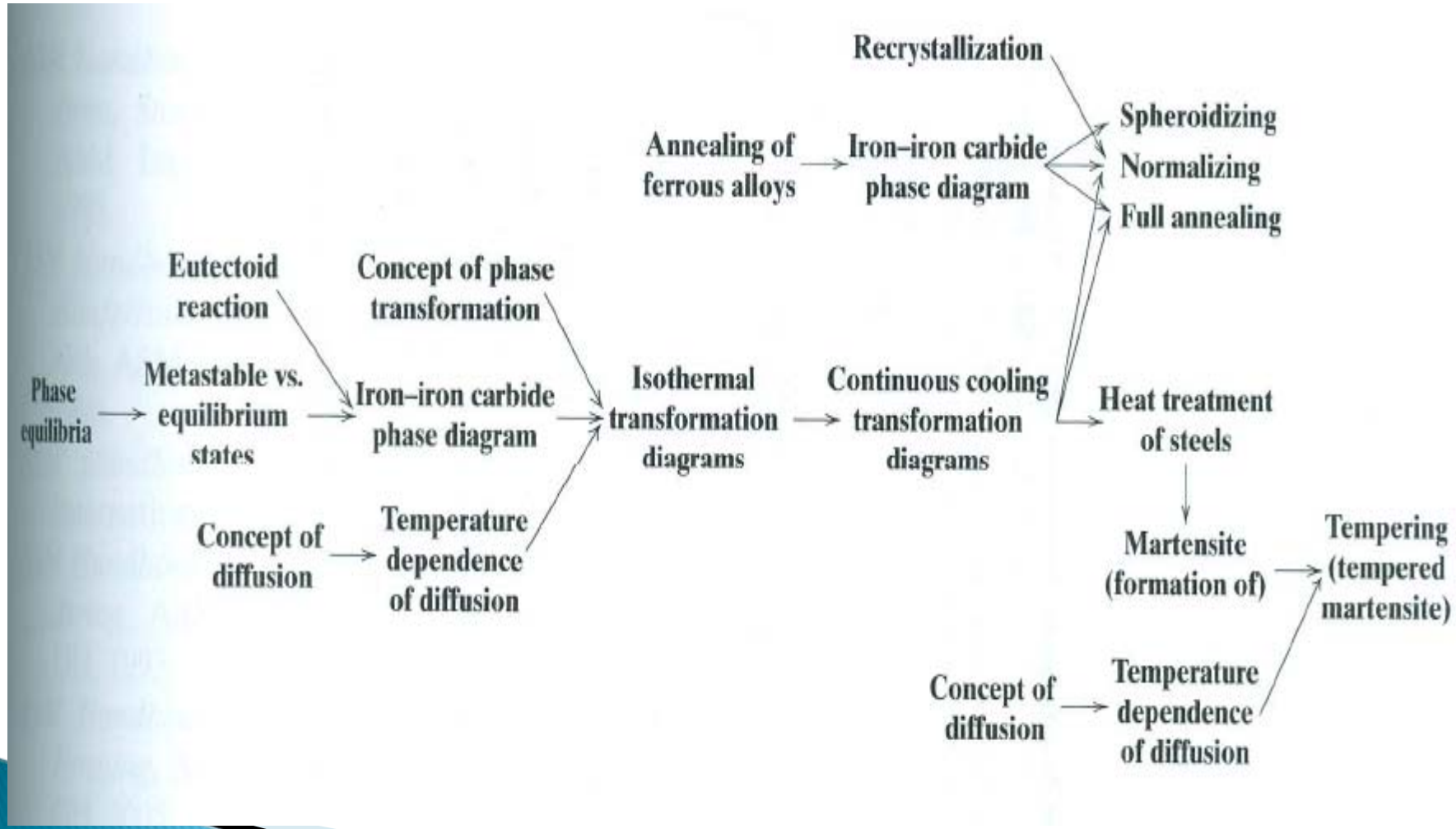
Structural metallic materials

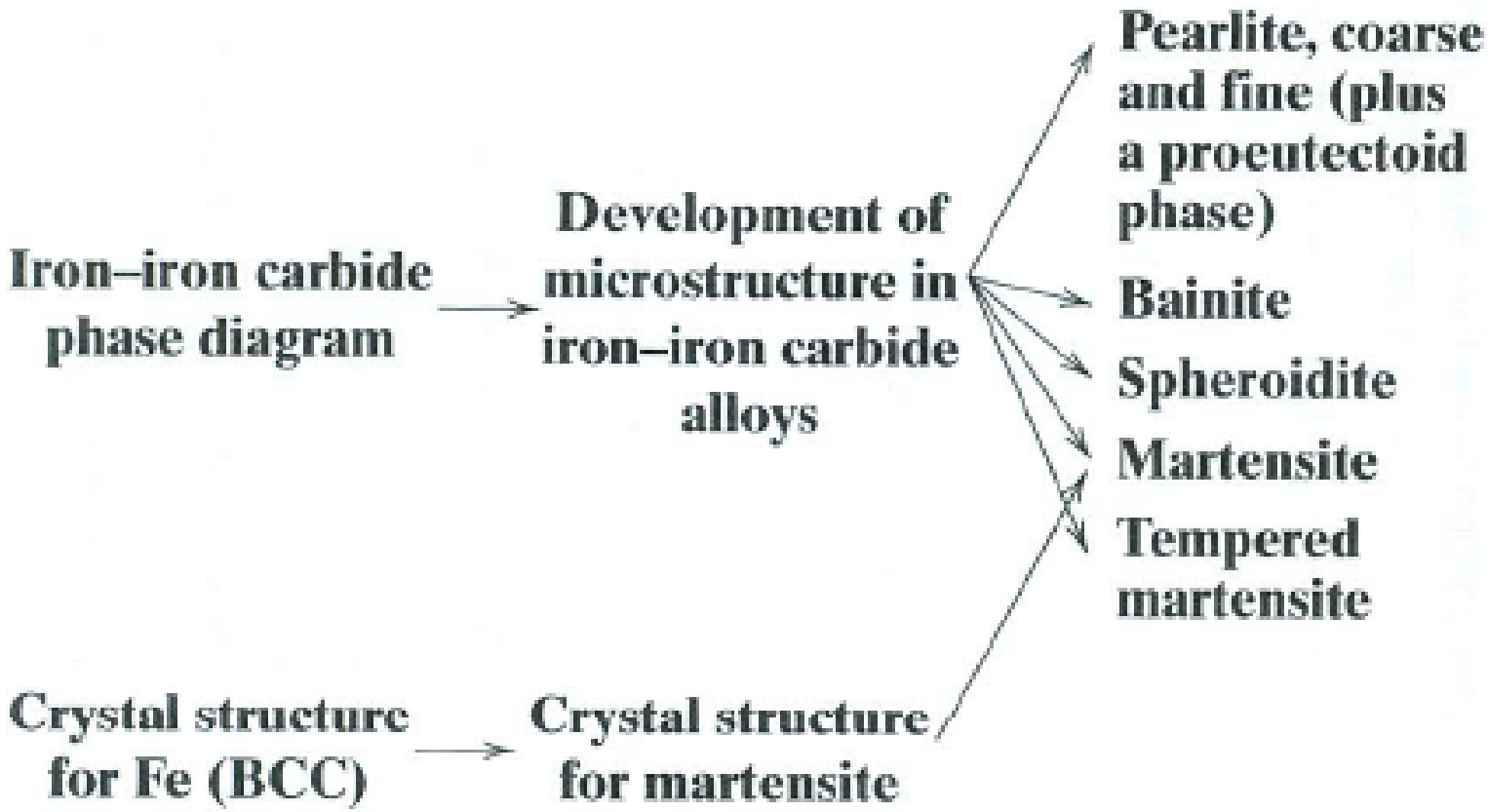
PROCESSING



SIAE

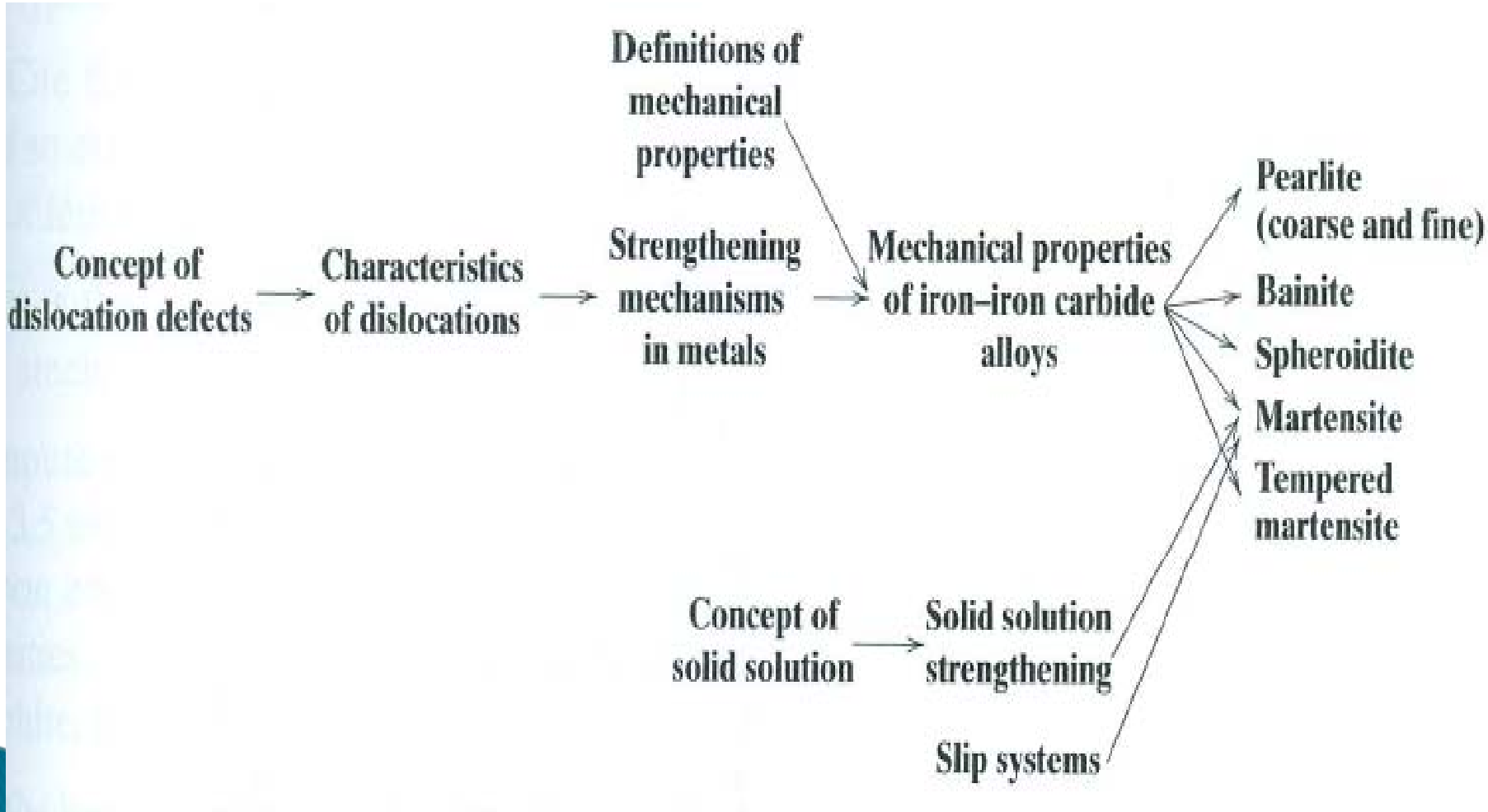
Structural metallic materials

STRUCTURE



SIAE

Structural metallic materials



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Structural metallic materials