10.8 It is known that the kinetics of recrystallization for some alloy obeys the Avrami equation, and that the value of n in the exponential is 5.0. If, at some temperature, the fraction recrystallized is 0.30 after 100 min, determine the rate of recrystallization at this temperature.

10.10 The kinetics of the austenite-to-pearlite transformation obeys the Avrami relationship. Using the fraction transformed–time data given here, determine the total time required for 95% of the austenite to transform to pearlite:

Fraction Transformed Time (s)

0.2 280

0.6 425

10.14 In terms of heat treatment and the development of microstructure, what are two major limitations of the iron–iron carbide phase diagram?

10.24 Name the microstructural products of eutectoid iron–carbon alloy (0.76 wt% C) specimens that are first completely transformed to austenite, then cooled to room temperature at the following rates:

 (a) 1°C/s

 (b) 20°C/s

 (c) 50°C/s

 (d) 175°C/s

10.39 Determine the approximate tensile strengths and ductilities (%RA) for specimens of a eutectoid iron–carbon alloy that have experienced the heat treatments described in parts (a) through (d) of Problem 10.24.

11.4 Compute the volume percent of graphite, VGr, in a 2.5 wt% C cast iron, assuming that all the carbon exists as the graphite phase. Assume densities of 7.9 and 2.3 g/cm3 for ferrite and graphite, respectively.

11.8 Is it possible to produce malleable cast iron in pieces having large cross-sectional dimensions? Why or why not?

11.16 Compare sand, die, investment, lost-foam, and continuous casting techniques.

11.22 Give the approximate temperature at which it is desirable to heat each of the following iron–carbon alloys during a full anneal heat treatment:

 (a) 0.20 wt% C

 (b) 0.60 wt% C

 (c) 0.76 wt% C

 (d) 0.95 wt% C.

11.28 Construct radial hardness profiles for the following:

 (a) A cylindrical specimen of an 8640 steel alloy of diameter 75 mm (3 in.) that has been quenched in moderately agitated oil

 (b) A cylindrical specimen of a 5140 steel alloy of diameter 50 mm (2 in.) that has been quenched in moderately agitated oil