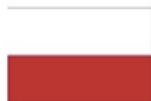




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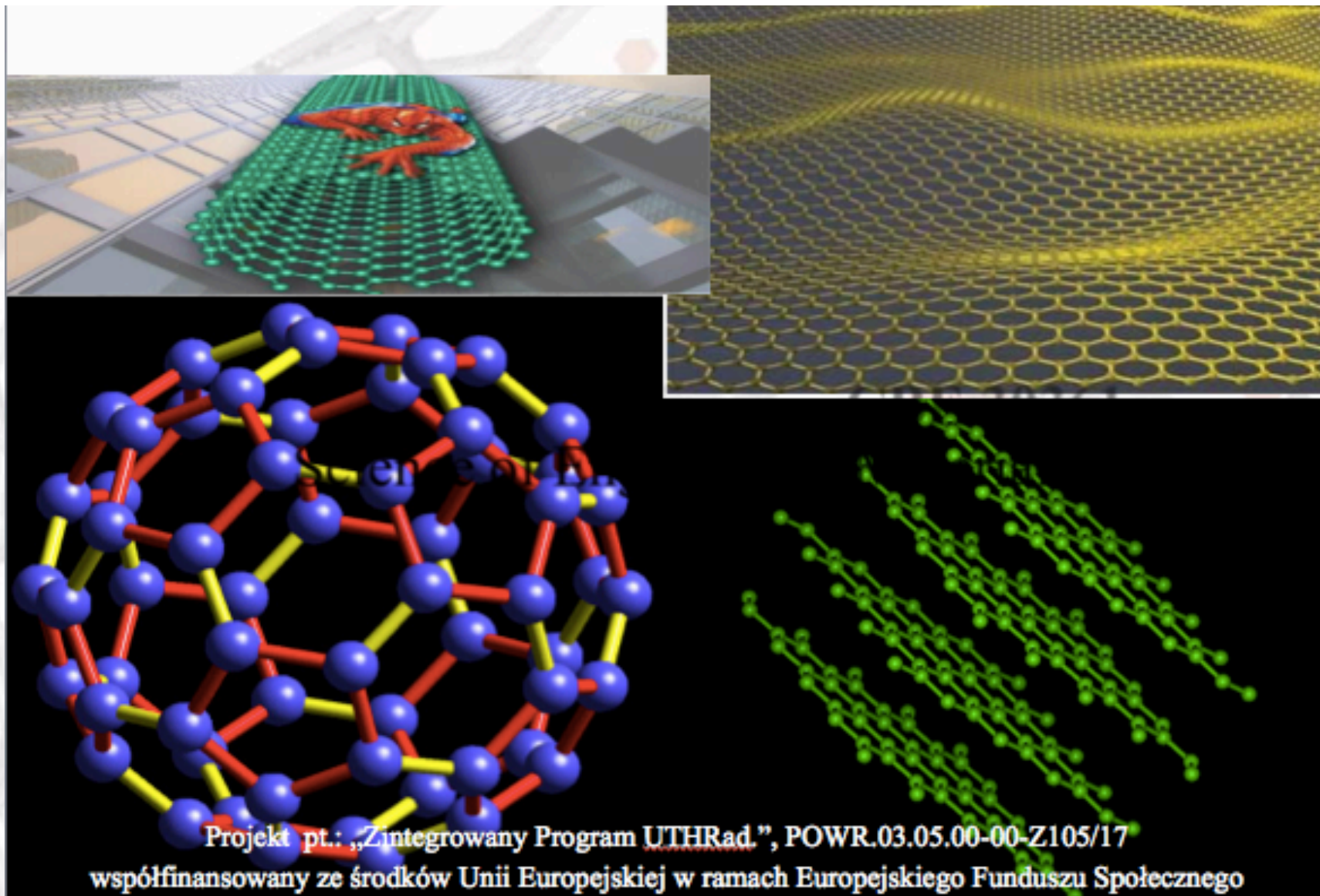


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**Course Number:1**

**Course Title: Science of Engineering Materials**

**Lecture №05**

Composite materials based on nitrides of refractory materials.

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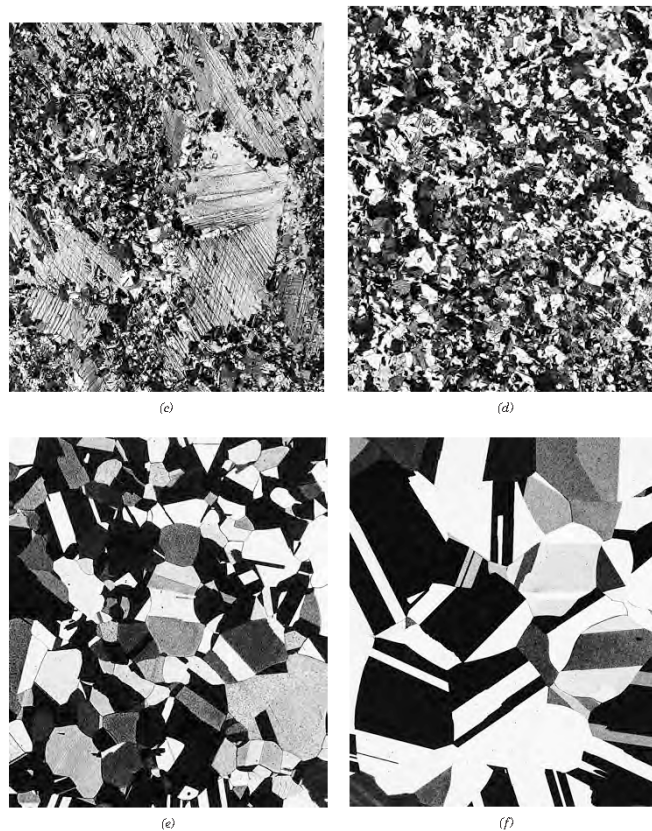


Figure 1. Silicon Nitride Ball Bearings



Figure 2. Silicon Nitride Turbocharger Rotor





**Figure 7.21** (continued)

speckled grains are those that have recrystallized. Thus, recrystallization of cold-worked metals may be used to refine the grain structure.

Also, during recrystallization, the mechanical properties that were changed as a result of cold working are restored to their precold-worked values; that is, the metal becomes softer, weaker, yet more ductile. Some heat treatments are designed to allow recrystallization to occur with these modifications in the mechanical characteristics (Section 11.7).

Recrystallization is a process the extent of which depends on both time and temperature. The degree (or fraction) of recrystallization increases with time, as may be noted in the photomicrographs shown in Figures 7.21a–d. The explicit

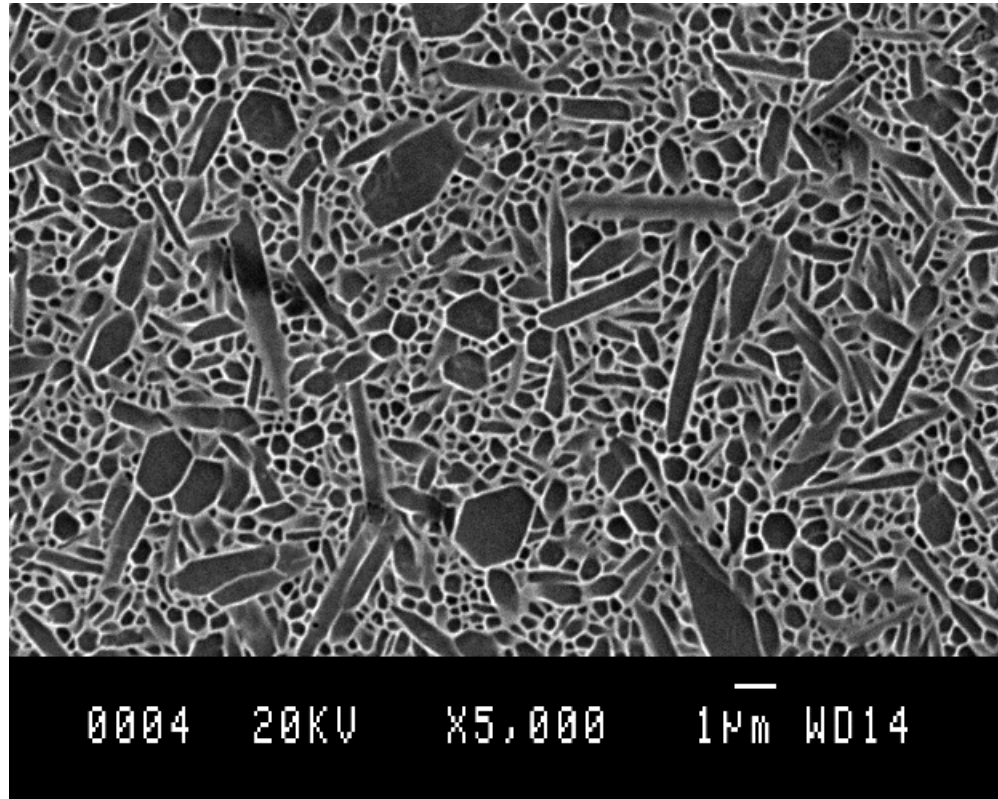
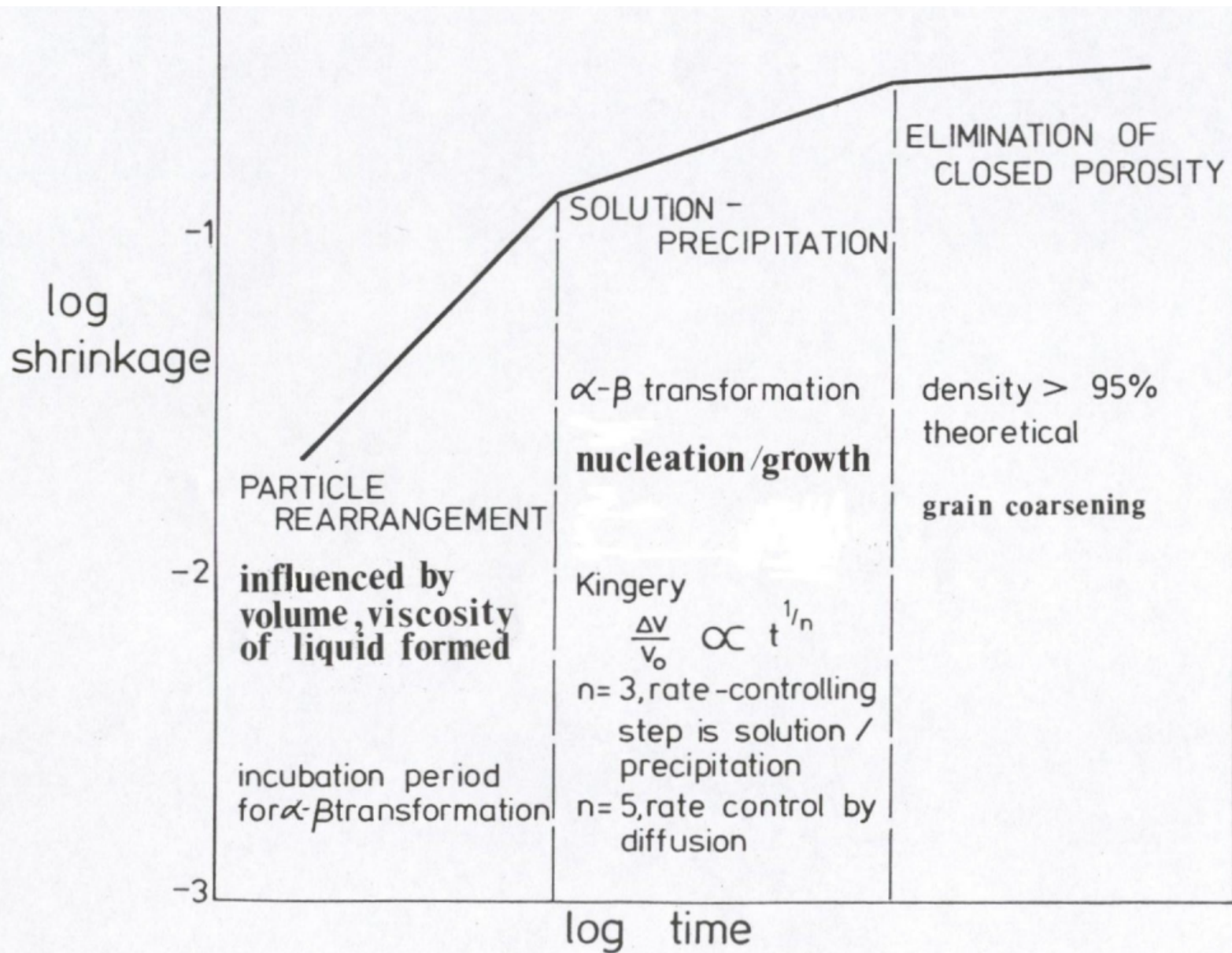
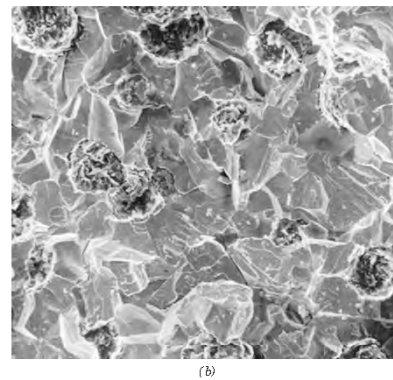
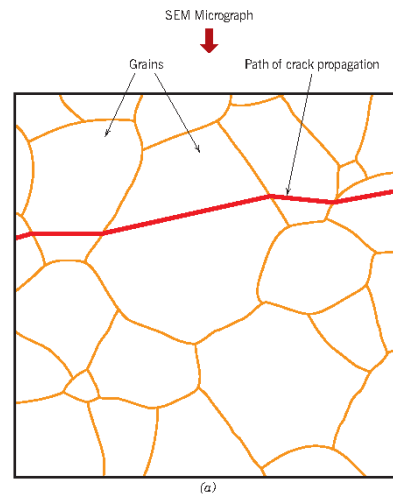


Figure. Scanning electron micrograph of silicon nitride densified with 6 wt.% yttria and 2 wt. % alumina



Schematic log shrinkage – log time plot showing 3 stages of liquid phase sintering of silicon nitride ceramics according to model of Kingery



**Figure 8.6** (a) Schematic cross-section profile showing crack propagation through the interior of grains for transgranular fracture. (b) Scanning electron fractograph of ductile cast iron showing a transgranular fracture surface. Magnification unknown. [Figure (b) from V. J. Colangelo and F. A. Heiser, *Analysis of Metallurgical Failures*, 2nd edition. Copyright © 1987 by John Wiley & Sons, New York. Reprinted by permission of John Wiley & Sons, Inc.]