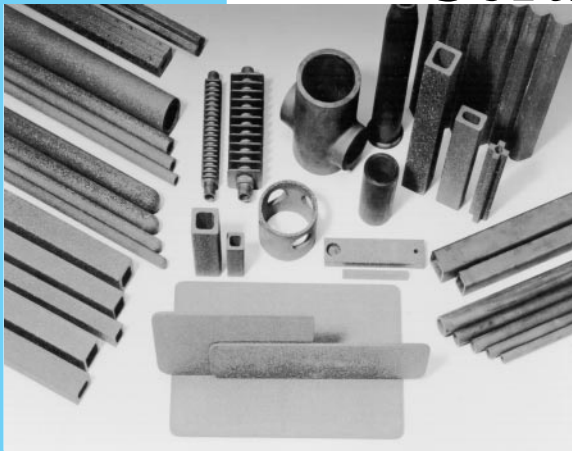


CHAPTER 12

Ceramics and Glasses



Ceramics have traditionally been used in high-temperature engineering applications. For the interior architecture of furnaces, silicon carbide provides good dimensional stability at temperatures up to 1,650° C, along with high resistance to thermal shock and corrosion and a low density. (Courtesy of Bolt Technical Ceramics.)

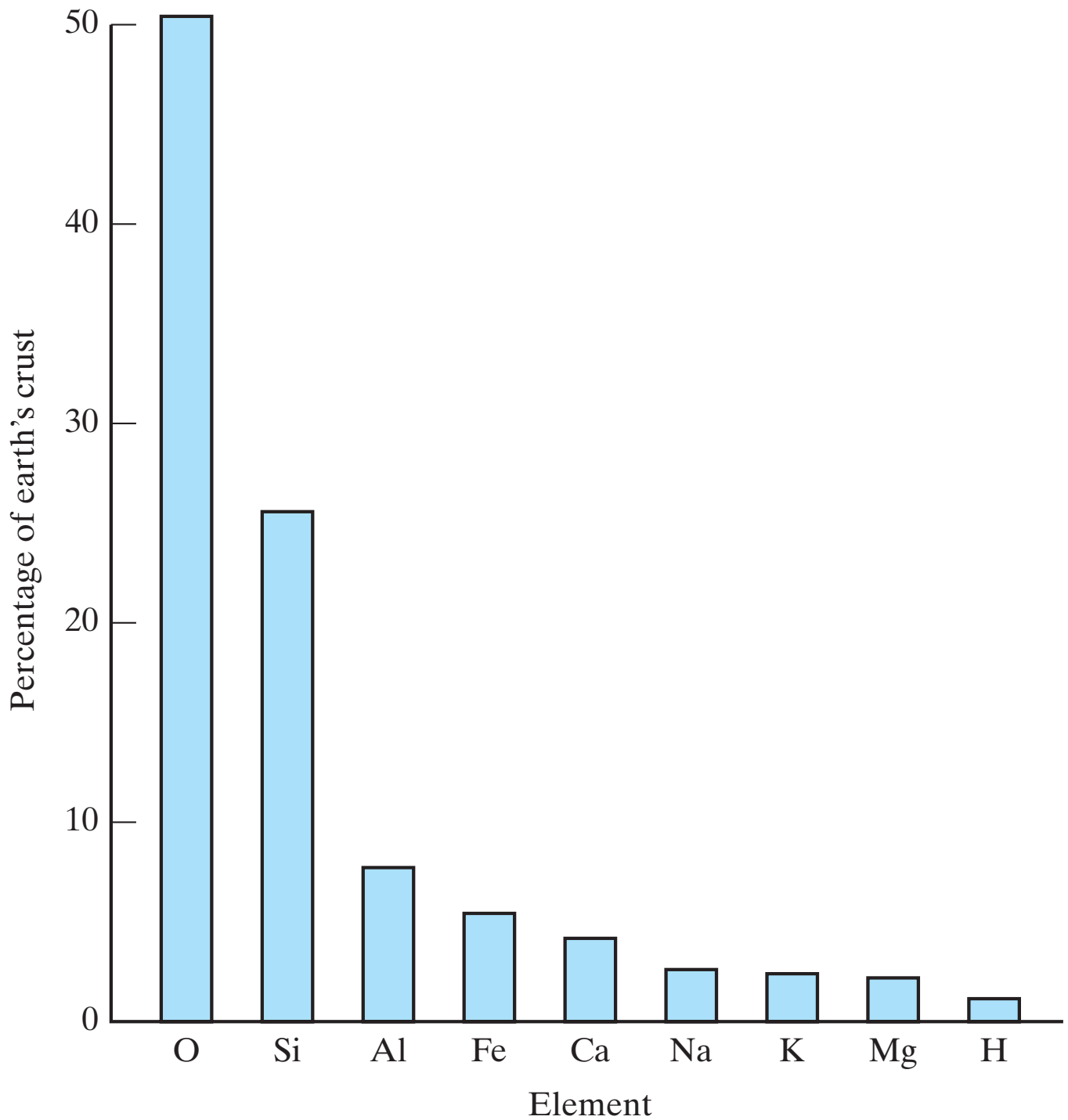
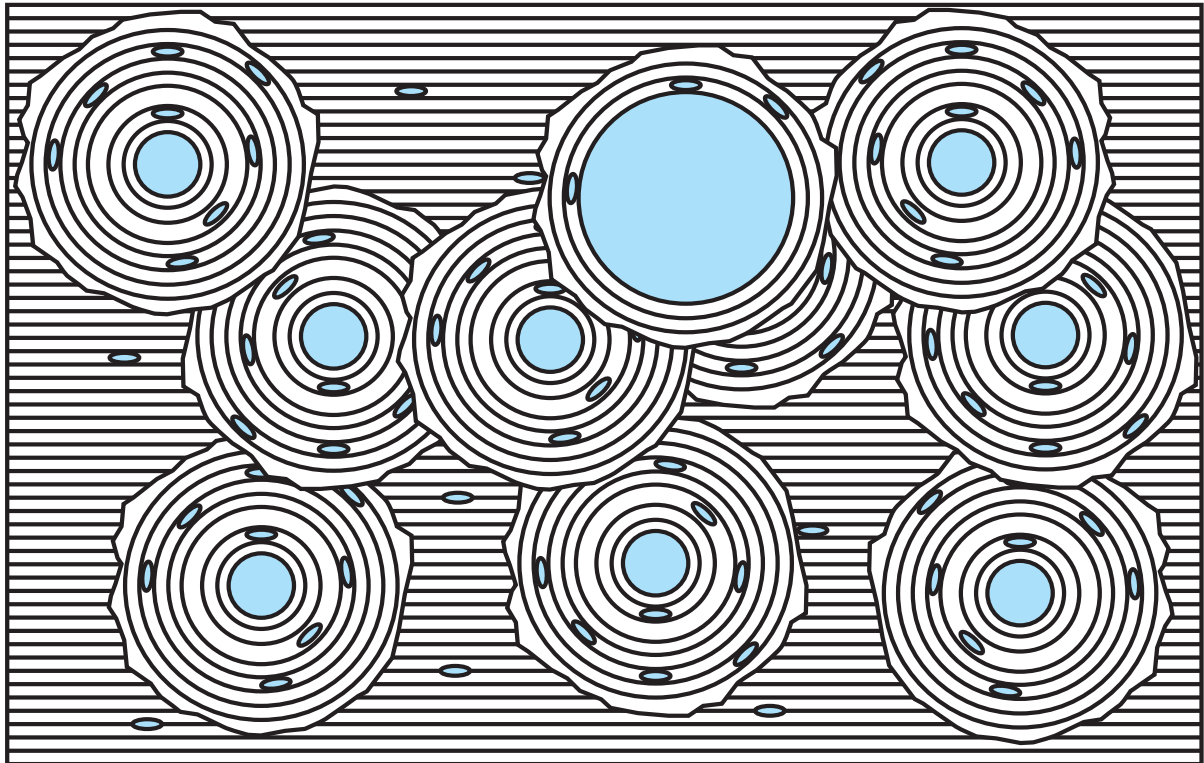


Figure 12-1 *The relative abundance of elements in the earth's crust illustrates the availability of ceramic minerals, especially the silicates.*



(Courtesy of R. B. Martin, Orthopaedic Research Laboratories, University of California, Davis Medical Center, Sacramento, CA)



Schematic illustration of osteon cells in a matrix of primary bone. (From R. B. Martin, "Bone as a Ceramic Composite Material," in Bioceramics—Applications of Ceramic and Glass Materials in Medicine, Ed. J. F. Shackelford, Trans Tech Publications, Switzerland, 1999)

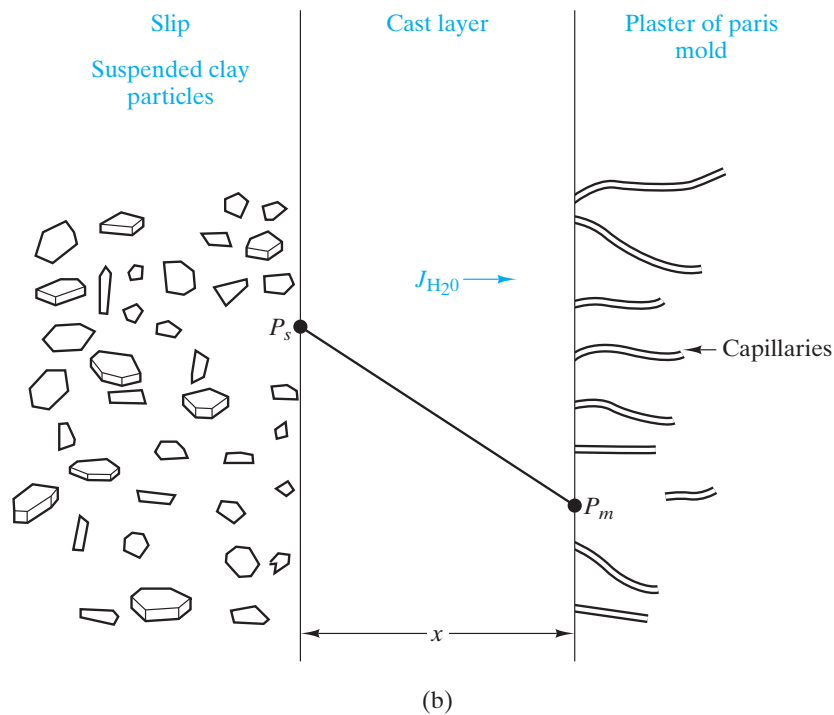
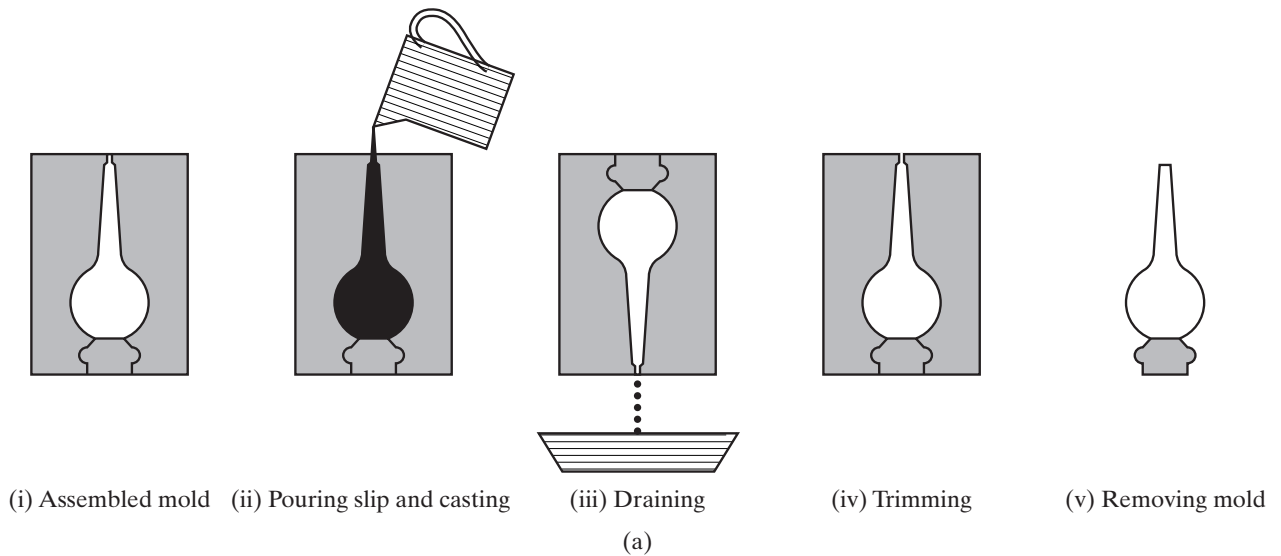


Figure 12-2 (a) Schematic illustration of the slip casting of ceramics. The slip is a powder–water mixture. (After F. H. Norton, *Elements of Ceramics*, 2nd Ed., Addison-Wesley Publishing Co., Inc., Reading, Mass., 1974.) (b) Much of that water is absorbed into the porous mold. The final form must be fired at elevated temperatures to produce a structurally strong piece. (From W. D. Kingery, H. K. Bowen, and D. R. Uhlmann, *Introduction to Ceramics*, 2nd Ed., John Wiley & Sons, Inc., New York, 1976.)

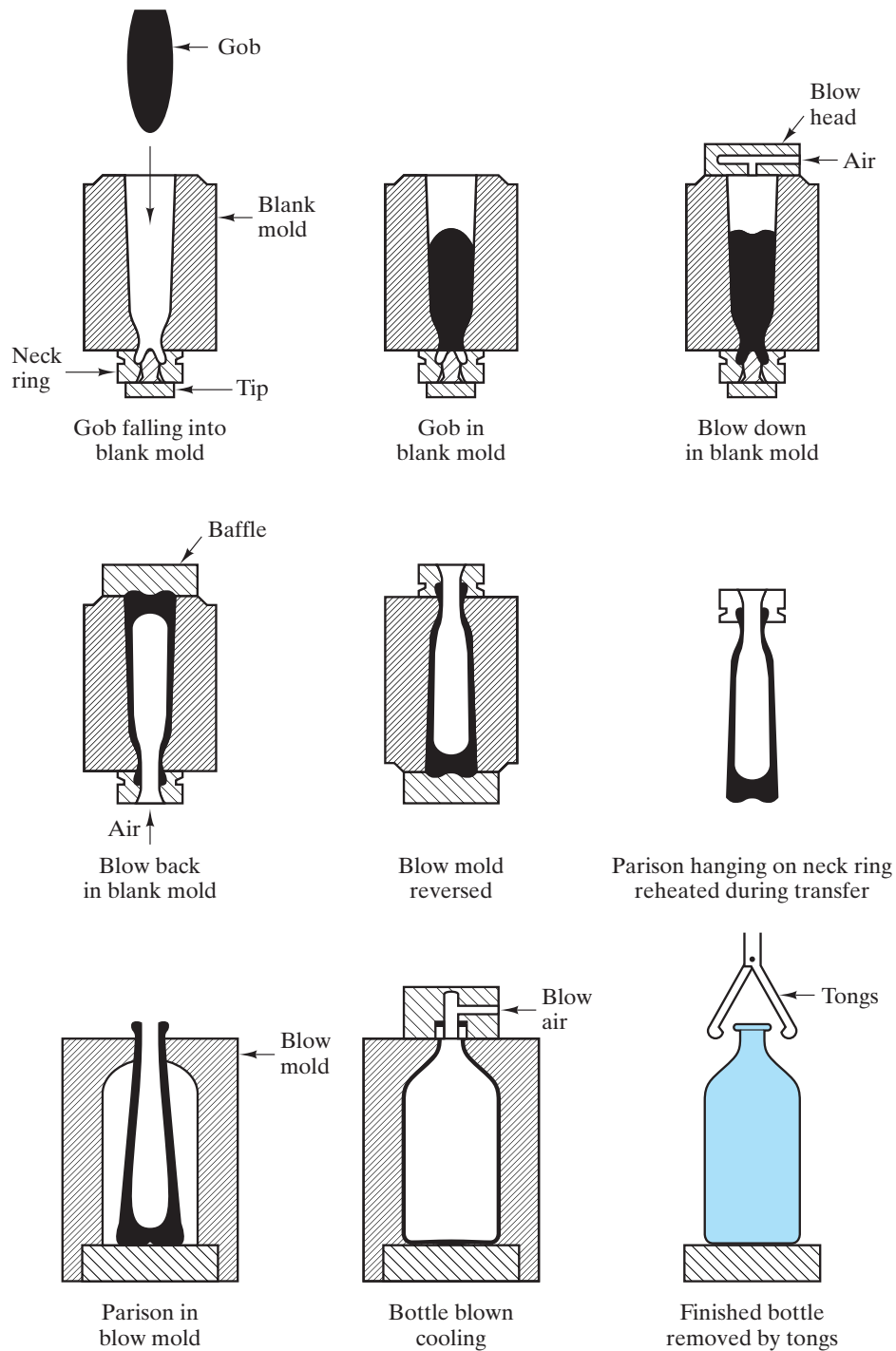


Figure 12-3 *The formation of a glass container requires careful control of the material's viscosity at various stages. (From F. H. Norton, Elements of Ceramics, 2nd Ed., Addison-Wesley Publishing Co., Inc., Reading, Mass., 1974.)*

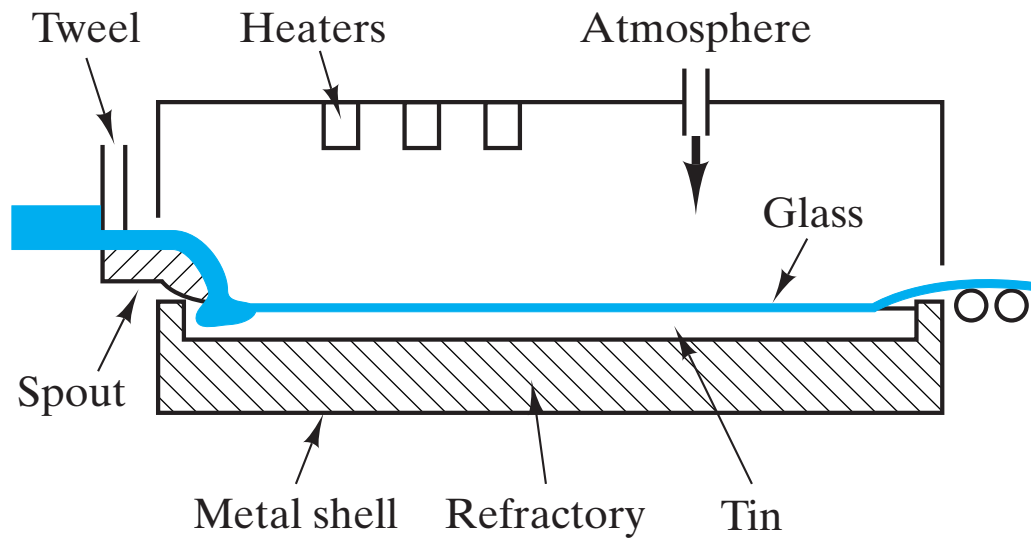


Figure 12-4 *The high degree of flatness achieved in modern architectural plate glass is the result of the float glass process in which the layer of glass is drawn across a bath of molten tin. (After Engineered Materials Handbook, Vol. 4, Ceramics and Glasses, ASM International, Materials Park, Ohio, 1991.)*

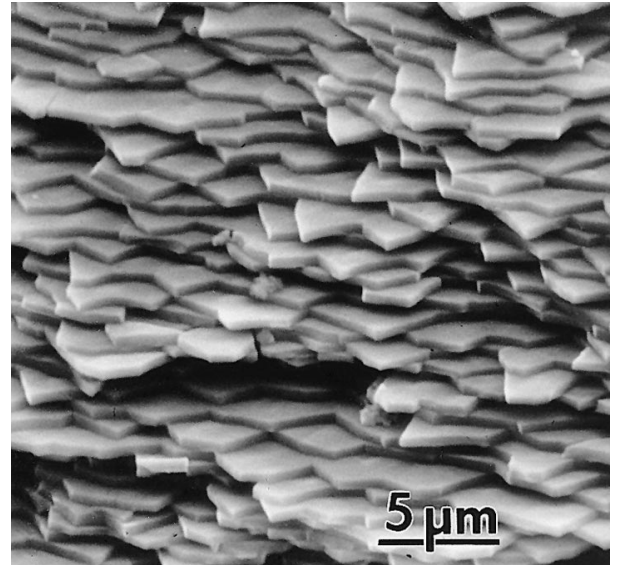
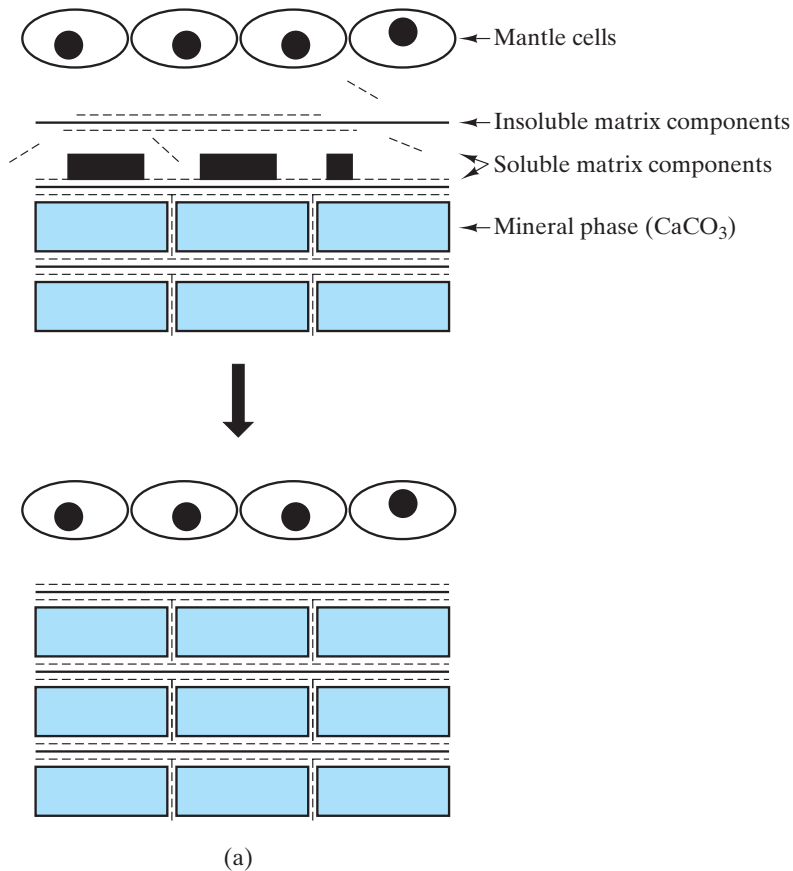


Figure 12-5 (a) A schematic of the formation of an abalone shell. Shown is a layer of nacre, composed of platelets of CaCO_3 bonded together by organic molecules (proteins and sugars). The production of such fracture-resistant structures by synthetic means is known as biomimetic processing. (After A. Heuer et al., *Science*, 255 1098–1105 (1992).) (b) A scanning electron micrograph of the nacre platelet structure. (Courtesy of Mehmet Sarikaya, University of Washington)

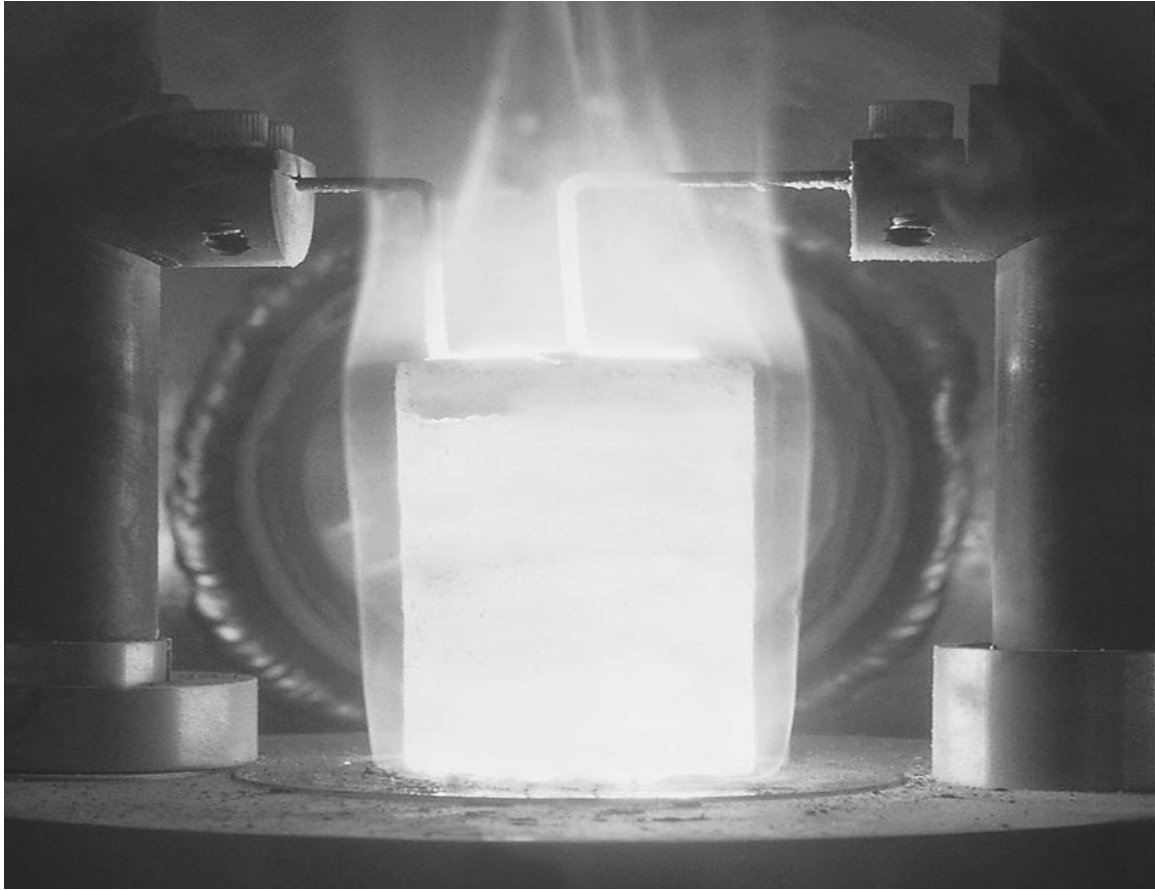


Figure 12-6 Ignition at the top of this Ti powder pellet in an atmosphere of N_2 gas leads to a self-sustaining reaction throughout the entire sample and the complete conversion to TiN. The appropriately named self-propagating high temperature synthesis (SHS) is an example of novel techniques for processing advanced materials. (Courtesy of Zuhair Munir, University of California, Davis)