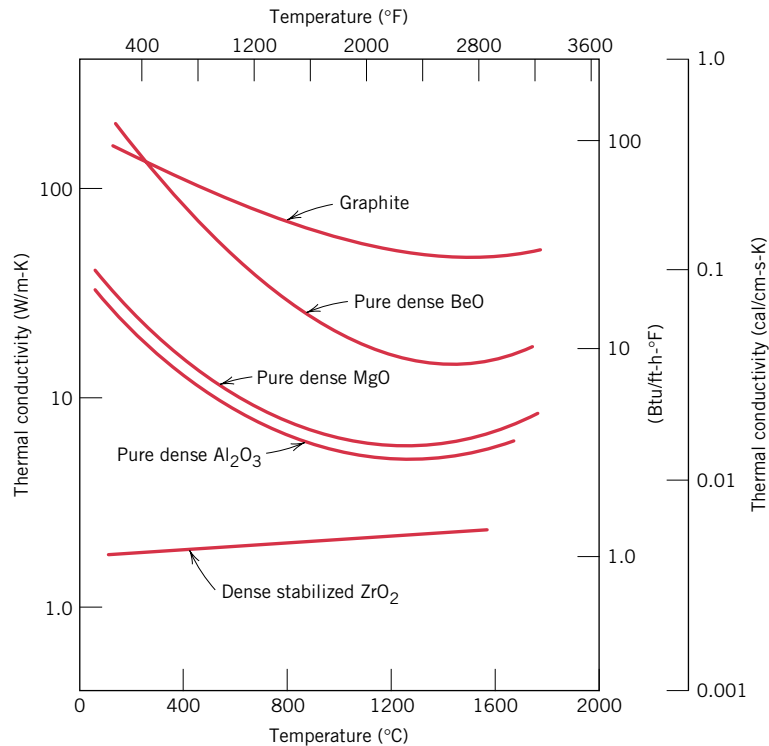


**Figure 17.5**  
Dependence of thermal conductivity on temperature for several ceramic materials. (Adapted from W. D. Kingery, H. K. Bowen, and D. R. Uhlmann, *Introduction to Ceramics*, 2nd edition. Copyright © 1976 by John Wiley & Sons, New York. Reprinted by permission of John Wiley & Sons, Inc.)



Thermal conductivity values for a number of ceramic materials are contained in Table 17.1; room-temperature thermal conductivities range between approximately 2 and 50 W/m-K. Glass and other amorphous ceramics have lower conductivities than crystalline ceramics, since the phonon scattering is much more effective when the atomic structure is highly disordered and irregular.

The scattering of lattice vibrations becomes more pronounced with rising temperature; hence, the thermal conductivity of most ceramic materials normally diminishes with increasing temperature, at least at relatively low temperatures (Figure 17.5). As Figure 17.5 indicates, the conductivity begins to increase at higher temperatures, which is due to radiant heat transfer: significant quantities of infrared radiant heat may be transported through a transparent ceramic material. The efficiency of this process increases with temperature.

Porosity in ceramic materials may have a dramatic influence on thermal conductivity; increasing the pore volume will, under most circumstances, result in a reduction of the thermal conductivity. In fact, many ceramics that are used for thermal insulation are porous. Heat transfer across pores is ordinarily slow and inefficient. Internal pores normally contain still air, which has an extremely low thermal conductivity—approximately 0.02 W/m-K. Furthermore, gaseous convection within the pores is also comparatively ineffective.

### ✓ **Concept Check 17.3**

The thermal conductivity of a single-crystal ceramic specimen is slightly greater than a polycrystalline one of the same material. Why is this so?

(The answer is given on the CD-ROM.)