

19.21 This question asks for us to decide, for each of several pairs of materials, which has the larger thermal conductivity and why.

(a) Pure silver will have a larger conductivity than sterling silver because the impurity atoms in the latter will lead to a greater degree of free electron scattering.

(b) Polycrystalline silica will have a larger conductivity than fused silica because fused silica is noncrystalline and lattice vibrations are more effectively scattered in noncrystalline materials.

(c) The poly(vinyl chloride) will have the larger conductivity than the polystyrene because the former will have the higher degree of crystallinity. Both polymers are syndiotactic and have the same degree of polymerization. However, with regard to side-group bulkiness, the PVC is more likely to crystallize. Since heat transfer is accomplished by molecular chain vibrations, and the coordination of these vibrations increases with percent crystallinity, the higher the crystallinity, the greater the thermal conductivity.

(d) The isotactic polypropylene will have a larger thermal conductivity than the atactic polypropylene because isotactic polymers have a higher degree of crystallinity. The influence of crystallinity on conductivity is explained in part (c).