**Material Properties Science**

**Homework #10**

**Due date：1/15/2018(before 12:00 noon)**

1. (a) Compute the electrical conductivity of a 7.0-mm (0.28-in.) diameter cylindrical silicon specimen 57 mm (2.25 in.) long in which a current of 0.25 A passes in an axial direction. A voltage of 24 V is measured across two probes that are separated by 45 mm (1.75 in.)

(b) Compute the resistance over the entire 57 mm (2.25 in.) of the specimen.

Ans:



2. At room temperature the electrical conductivity and the electron mobility for aluminum are 3.8 × 107 (Ω-m)-1 and 0.0012 m2/V-s, respectively. (a) Compute the number of free electrons per cubic meter for aluminum at room temperature. (b) What is the number of free electrons per aluminum atom? Assume a density of 2.7 g/cm3.

Ans:



3. An n-type semiconductor is known to have an electron concentration of 5 × 1017 m-3. If the electron drift velocity is 350 m/s in an electric field of 1000 V/m, calculate the conductivity of this material.

Ans:



4. Zinc telluride has a band gap of 2.26 eV. Over what range of wavelengths of visible light is it transparent?

Ans:



5. Briefly explain what determines the characteristic color of (a) a metal and (b) a transparent nonmetal.

Ans:



6. **(a)** Briefly explain why porosity decreases the thermal conductivity of ceramic and polymeric materials, rendering them more thermally insulative. **(b)** Briefly explain how the degree of crystallinity affects the thermal conductivity of polymeric materials and why.

ANS:

(a) Porosity decreases the thermal conductivity of ceramic and polymeric materials because the thermal conductivity of a gas phase that occupies pore space is extremely small relative to that of the solid material. Furthermore, contributions from gaseous convection are generally insignificant. Besites, pores or cracks cause severe phonon scattering.

(b) Increasing the degree of crystallinity of a semicrystalline polymer enhances its thermal conductivity; the vibrations, rotations, etc. of the molecular chains are more effective modes of thermal transport when a crystalline structure prevails.