ECE 204
Spring 2001
Prof. J. E. Ayers

Homework Assignment 1 **SOLUTION**

1. Calculate the resistance of a pure silicon sample, 4 cm long, and with a cross sectional area of 1 cm x 1 cm, at room temperature. Repeat for a sample of pure copper with the same dimensions.

Silicon sample: $R = \frac{\rho L}{A} = \frac{50 \times 10^3 \Omega cm(4cm)}{(1cm)(1cm)} = 200k\Omega$

Copper sample: $R = \frac{\rho L}{A} = \frac{10^{-6} \Omega cm(4cm)}{(1cm)(1cm)} = 4\mu\Omega$

2. Calculate the resistance of a copper wire, 1 mm in diameter and 2 km in length.

$$R = \frac{\rho L}{A} = \frac{10^{-6} \Omega cm(2 \times 10^5 cm)}{\pi(0.05cm)^2} = 25.5\Omega$$

3. Calculate the intrinsic (not including the series resistance) dynamic resistance of a silicon diode operating at 1 mA. Repeat for the case of 20 mA.

@1mA: $r_d = \frac{26mV}{1mA} = 26\Omega$

@20mA: $r_d = \frac{26mV}{20mA} = 1.3\Omega$

4. Obtain the data sheet for a Panasonic MAZ3100 zener diode and attach it. What is the tolerance on V_Z (in percent)? What is the maximum operating temperature? What is the maximum DC current?

V_Z tolerance = $\pm$6%
Maximum junction temperature = 150°C
Maximum DC current = 200mW/10V=20mA

5. Using the sources of information at your disposal, determine the band gap and at least one device application for the semiconductor GaN.

E_g = 3.4 eV

Applications: blue laser diodes, high-speed transistors