Physics 8550 – Physics of Thin Films

Assignment #5

(due to Monday, April 05, 2017)

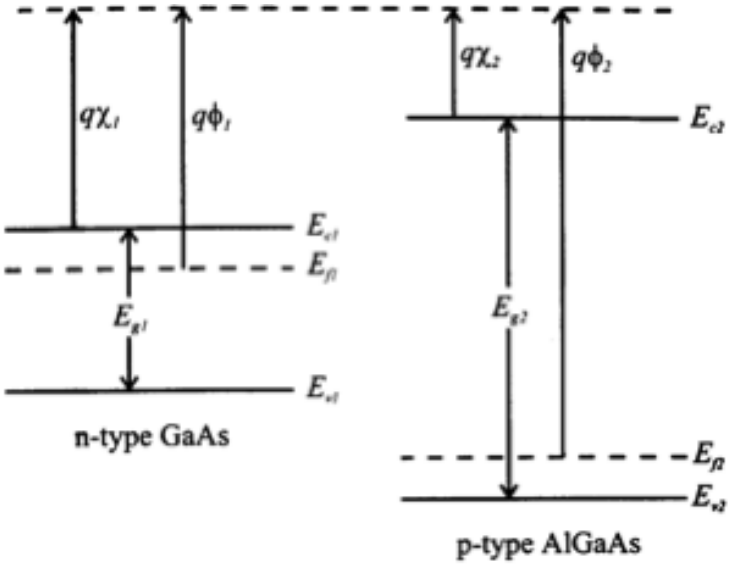
1) a. Calculate the number of free electrons for gold using its density an its atomic mass.

$$\rho_{Au} = 19.3 \left[\frac{g}{cm^3} \right], \quad M_{Au} = 196.967 \left[\frac{g}{mol} \right] \qquad \text{(15 points)}$$

b. Calculate the Fermi energy for Silver assuming $6.1 \cdot 10^{22}$ free electrons / cm^3. Assume $m^* = m_0$. (15 points)

2) Two materials, n-type GaAs and p-type AlGaAs are brought together to form a heterojunction.

E_g(GaAs)	= 1.45 eV
E_g(AlGaAs)	= 2.05 eV
χ_{GaAs}	= 4.07 eV
χ_{AlGaAs}	= 3.82 eV
Φ_{GaAs}	= 4.27 eV
Φ_{AlGaAs}	= 5.65 eV
$n_{(GaAs)}$	= $2 \cdot 10^6$ cm^{-3}
$n_{(AlGaAs)}$	= $5 \cdot 10^6$ cm^{-3}



a. Draw the junction after contact. (15 points)
b. Draw the energy band diagram after contact and system in equilibrium! (15 points)
c. Calculate the doping concentrations N_D in GaAs and N_A in AlGaAs. (20 points)
d. Calculate the band-edge discontinuity. (10 points)
e. How large is the built-in voltage? ($k_B \cdot T = 26$ meV) (10 points)