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ECE 6450
HW #1

(4) (a) Doping profile is a plot of dopant concentration as a function of depth.

I will plot $C(x,t) = C_s \operatorname{erfc} \frac{x}{2\sqrt{Dt}}$

where C_s = solid solubility of P in Si at 925°C ≈ $8 \times 10^{20} cm^{-3}$ (fig. 2.4)

t = 60 min = 3600s

$T = 925°C = 1198.15K$

$D = D_o e^{-E_a/kT} + D_o^- e^{-E_a^-/kT} + D_o^= e^{-E_a^=/kT}$ (From table 3.2)

$= (3.9\,cm^2/s) e^{-(3.66\,eV)/((8.617\times10^{-5}\,eV/K^{-1})(1198.15K))}$

$+ (4.4\,cm^2/s) e^{-(4.0\,eV)/((8.617\times10^{-5}\,eV/K^{-1})(1198.15K))}$

$+ (44.0\,cm^2/s) e^{-(4.37eV)/((8.617\times10^{-5}\,eV/K^{-1})(1198.15K))}$

$= (1.65 \times 10^{-15}\,cm^2/s) \cdot \left(\frac{10{,}000\,\mu m}{1\,cm}\right)^2 = 1.65 \times 10^{-7}\,\mu m^2/s$

So $C(x, 3600s) = 8 \times 10^{20}\,cm^{-3} \operatorname{erfc}\left(\frac{x}{2\sqrt{(1.65\times10^{-7}\mu m^2/s)(3600s)}}\right)$

$C(x, 60\,min) = 8\times10^{20}\,cm^{-3}\left[1 - \operatorname{erf}\left(\frac{x}{0.0487442\,\mu m}\right)\right]$

If the argument of erf goes beyond ~4, the function returns a value of almost exactly 1.

So to get a non-zero concentration,

$\frac{x}{0.0487\,\mu m} < 4 \Rightarrow x < 4(0.0487\,\mu m) \Rightarrow x < 0.19\,\mu m$

That's an ORDER OF MAGNITUDE less than what we should be seeing ($x_j = 1.3\,\mu m$)