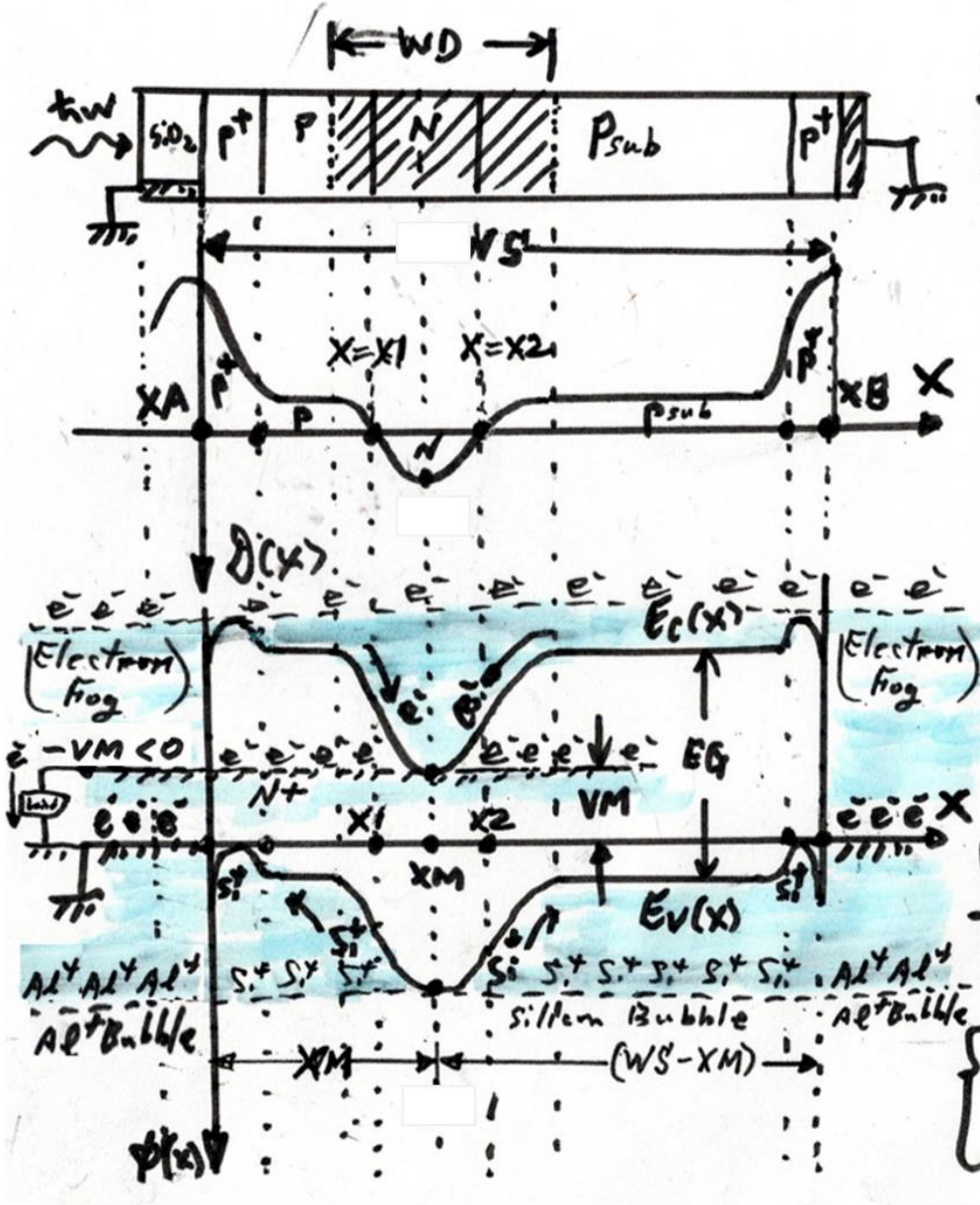
# Electrostatic Potential Analysis of the Pinned-surface P+PNPsubP+ Double Junction Photodiode




$$\begin{cases} p(x) = N_V \exp\left[\dfrac{E_F - E_V(x)}{kT}\right]; \\ n(x) = N_C \exp\left[\dfrac{E_C(x) - E_F}{kT}\right]; \end{cases}$$

$$p(x)\,n(x) = N_C N_V \exp\left(-\frac{E_G}{kT}\right) = n_i^2;$$

$$E_V(x) - E_C(x) = E_G;$$

$$\Psi(x) = (N)\exp\left[-\left(\frac{x-x_N}{r_N}\right)^2\right] - P_{sub} - (P)\exp\left[-\left(\frac{x+x_P}{r_P}\right)^2\right] - (P_B)\exp\left[-\left(\frac{x_B-x}{r_B}\right)^2\right];$$

$$\rho(x) = \Psi(x) + p(x) - n(x);$$

$$\varepsilon_{Si}\frac{d^2\phi}{dx^2} = -\rho(x);$$

$$\begin{cases} \text{At } x = x_M,\ \phi = -V_M < 0; \\ E_F = 0 \text{ and } \dfrac{d\phi}{dx} = 0; \end{cases}$$

$$\begin{cases} \phi(x) = E_C(x); \\ x_A = 0; \\ x_B = WS; \end{cases} \quad \begin{cases} \text{At } x = 0 \text{ and } x_B, \\ \phi = -E_G; \\ \dfrac{d\phi}{dx} = 0; \end{cases}$$