PN Diode Exercise: Series Resistance

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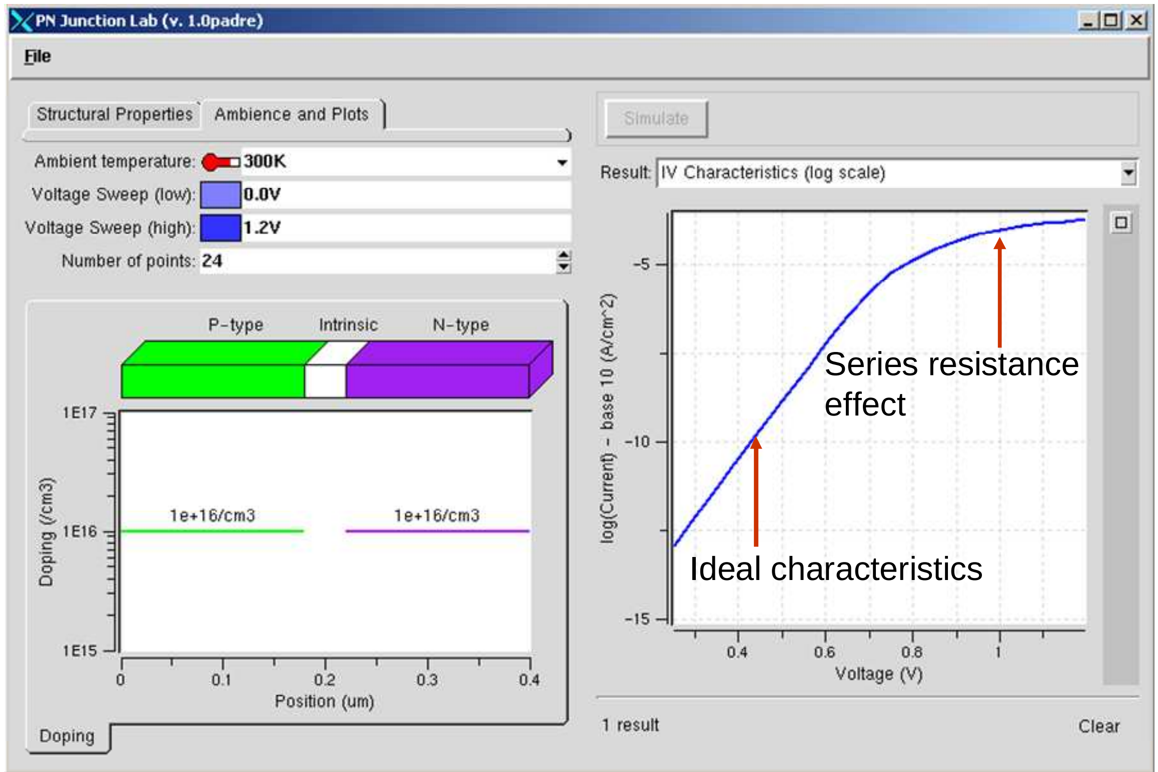
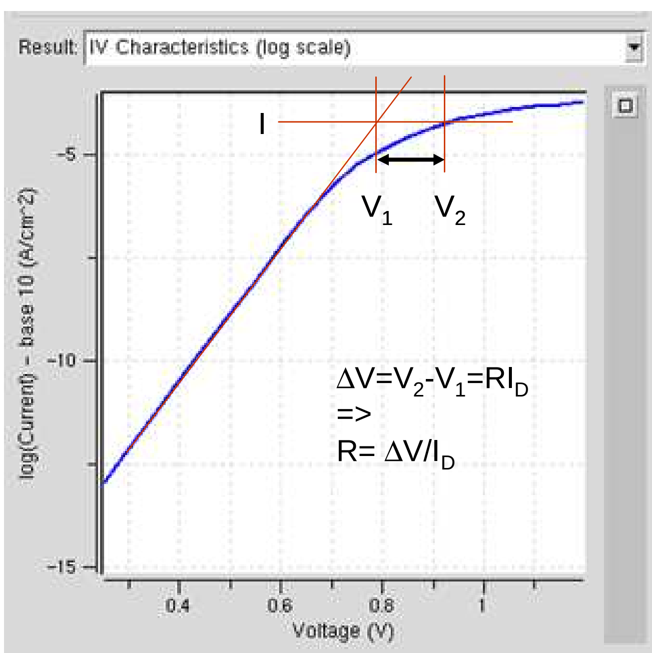
In this exercise we will examine the series resistance effects under high bias conditions. The p-side doping is $N_A=10^{16}$ cm^{-3} and the n-side doping is $N_D=10^{16}$ cm^{-3}. The length of the p-side and the n-side region is taken to be 1 um. Plot the following variables:

(a) Conduction band, valence band and the intrinsic level variation vs. position for applied bias V_A=0.7 V.

(b) Quasi-Fermi level variation for V_A=0.7 V.

(c) Forward IV-characteristics of a diode for applied bias between 0 and 1.2 V in 0.05 V increments. From the forward IV-characteristics under high bias conditions extract the series resistance.





The ideal diode current is

$$I \approx I_0 \exp\left(\frac{V_1}{V_T}\right)$$

The non-ideal diode current is:

$$I \approx I_0 \exp\left(\frac{V_2 - RI}{V_T}\right)$$

From the equality of the currents we have:

$$R = \frac{V_2 - V_1}{I}$$