Detection of Light. Problem Set 8

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1 Potential in the depletion region of a Buried Channel CCDs

In a buried channel CCD, the depletion region consists of two zones: one in the n-type region, just under the SiO_2 layer with a net excess hole density N_D and the second one, in the p-type region, with an excess negative ion density N_A. Solve the Poisson equation inside the depletion region, applying the appropriate boundary conditions to find the shape of the potential as a function of distance in the depletion region.

Tip: Outside the depletion region the material is assumed to be conducting enough so that the electric field there is zero. Also, both the electric field and the potential must be continuous in the junction.

2 Load curve in bolometers

At any point on the load curve of a bolometer we can define the quatity **Z** as:

$$\mathbf{Z} = \frac{\mathrm{dV}}{\mathrm{dI}}$$

where V and I are respectively the voltage and the load current accross the bolometer. Notice that this is different from the resistance $R = V/I$, due to the non-linearity of the load curve. Show that the following expressions are correct:

$$\mathbf{Z} = R\frac{\mathrm{d(\log V)}}{\mathrm{d(\log I)}}$$

$$R\frac{\mathrm{d(\log V)}}{\mathrm{d(\log I)}} = R\frac{\left[\frac{\mathrm{d(\log P)}}{\mathrm{d(\log R)}} + 1\right]}{\left[\frac{\mathrm{d(\log P)}}{\mathrm{d(\log R)}} - 1\right]}$$

where P is the power dissipated acroos the bolometer.