

Implantation of Ions for doping Silicon

$$e \approx 1.6 \times 10^{-19} \text{ coul}$$

$$m \approx 10^{-26} \text{ kg}$$

$$nm \approx 10^{-9} \text{ m}$$

$$\text{keV} \approx 1000 \text{ eV}$$

$$Z_{m_P}(E) \approx 0.0018 \frac{E^{0.9}}{\text{keV}}$$

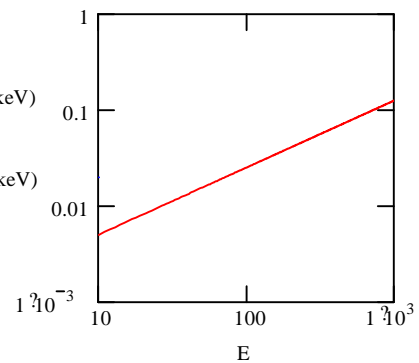
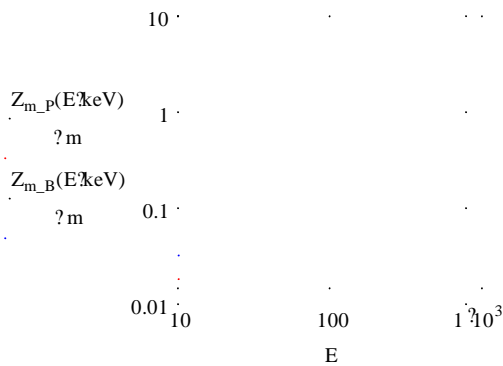
$$Z_{m_B}(E) \approx 0.004 \frac{E^{0.9}}{\text{keV}}$$

$$z_{z_P}(E) \approx 0.001 \frac{E^{0.7}}{\text{keV}}$$

$$z_{z_B}(E) \approx 0.01 \frac{E^{0.7}}{\text{keV}}$$

$$r_{r_P}(E) \approx 0.2 z_{z_P}(E)$$

$$r_{r_B}(E) \approx 0.2 z_{z_B}(E)$$

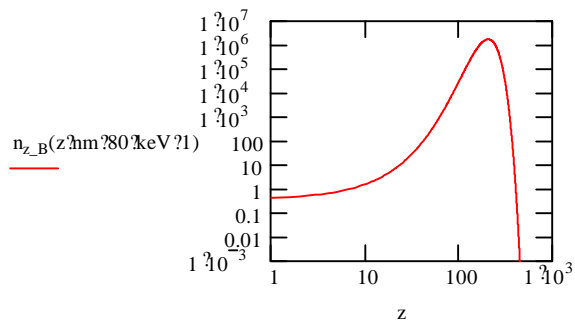


Concentration Profile is based upon Probability

$$n(z, t) \approx \frac{s}{\sqrt{2\pi} \sigma_z} \exp\left[-\frac{z^2}{2\sigma_z^2}\right] \exp\left[-\frac{r^2}{2\sigma_r^2}\right]$$

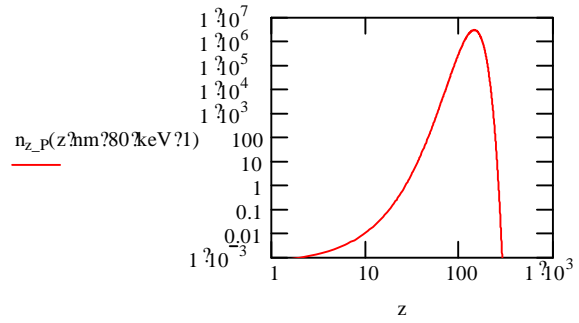
$$n_{z_B}(z, E, t) \approx \frac{s'}{\sqrt{2\pi} \sigma_{z_B}(E)} \exp\left[-\frac{z^2}{2\sigma_{z_B}(E)^2}\right]$$

Boron Implantation

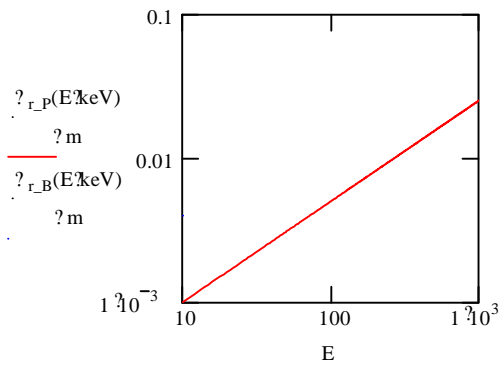


$$n_{z_P}(z, E, s) \approx \frac{s'}{3} \exp\left[-\frac{z}{\lambda} - \frac{Z_{m_P}(E)}{\sqrt{2}} \lambda_{z_P}(E)\right]$$

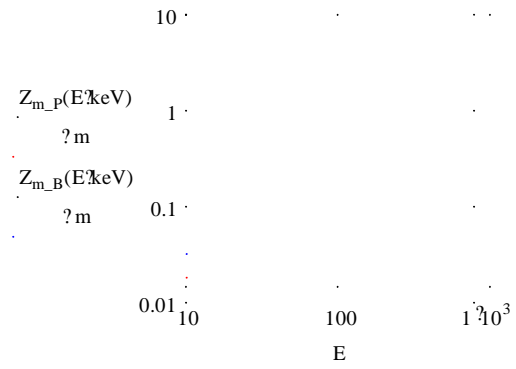
Phosphorus Implantation



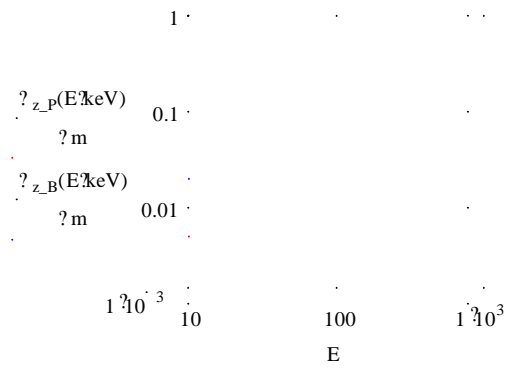
Lateral/Transvers Straggle



Projected Range



Projected Straggle



SiO₂ Implantation Mask for P doping

$$\lambda_{\text{mask}}(E) \approx 0.003 \mu\text{m} \left(\frac{E}{\text{keV}} \right)^{0.95}$$

$$\lambda_{\text{mask}}(10 \text{ keV}) \approx 0.027 \mu\text{m}$$

