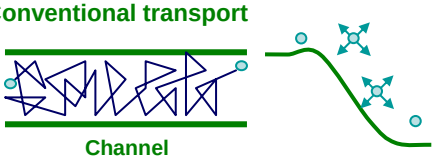
第一回複合創造領域シンポジウム

The Effect of Scattering in Drain Region of Ballistic Channel Diode

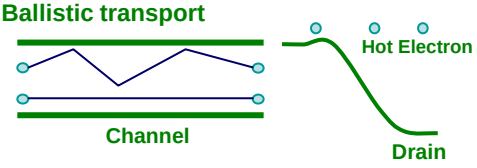
[1]Tokyo Tech. FRC, [2]Tokyo Tech. IGSSE ○A. Abudukelimu[1], K. Kakushima[2], P. Ahmet[1], K. Tsutsui[2], A. Nishiyama[2], N. Sugii[2],K. Natori[1], T. Hattori[1], H. Iwai[1]

Introduction

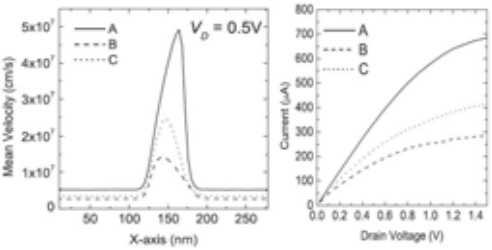
Conventional transport

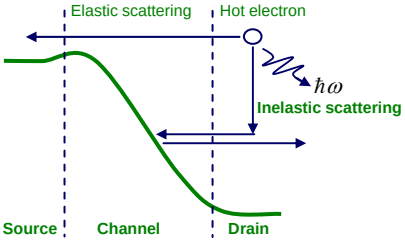


Ballistic transport



Influence of Hot Electrons in Drain Region on Ballistic Transport.

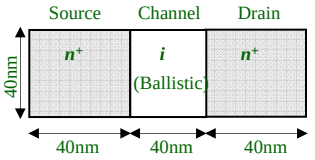




(A) Ballistic, (B) Elastic and Inelastic scattering,
(C) Elastic scattering only.

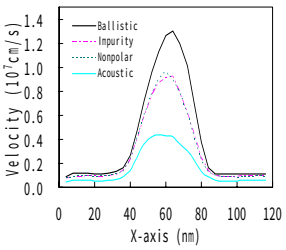
However, the role of scattering direction is not distinguished there.

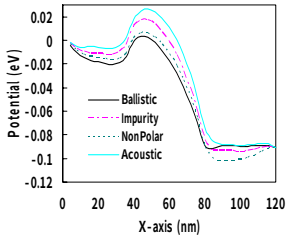
Results

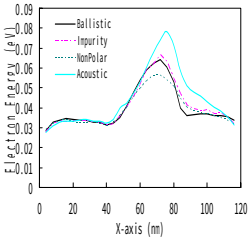


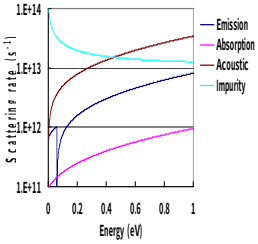
Schematic structure of n^+-i-n^+ diode.

Vd=0.1V







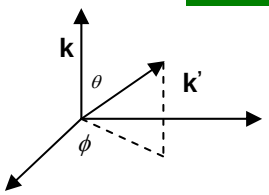


Discussion

Isotropic scattering

$$\phi = 2\pi r$$

$$\cos\theta = 1 - 2r$$



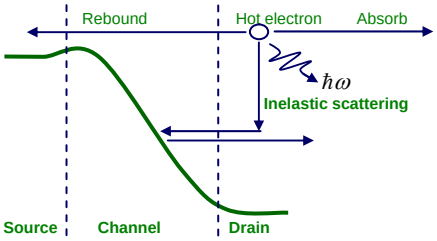
(Acoustic and Non-Polar phonon scattering)

Anisotropic scattering

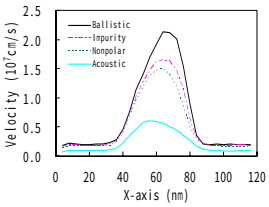
$$\phi = 2\pi r$$

$$\cos\theta = 1 - \frac{2r}{1 + (1-r)\left(\frac{2k}{q_D}\right)^2}$$

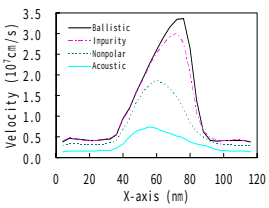
(Impurity scattering)



Vd=0.2V



Vd=0.4V



Ballisticity

$$r = \frac{I_{D\ with\ scatt.}}{I_{D\ bal.}}$$

Ratio of saturation current with scattering to saturation current without scattering.

Conclusion

The possibility of rebound and absorb is the main influence on carriers transport.

The influence of possibility of rebound and absorb is larger than the influence of scattering rate, carrier energy and bottleneck potential on carriers transport.

The carriers velocity and ballisticity of device will be decrease if the possibility of rebound is dominant in the drain region.

Influence of impurity scattering will be seriously decrease if the drain voltage is large enough.