

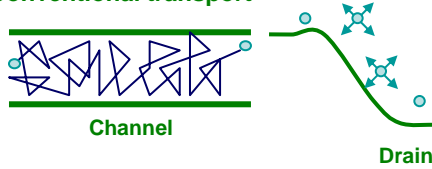


Influence of Phonon Generation of Hot Electrons in Drain Region on Ballistic Transport

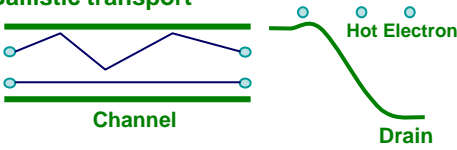
¹Tokyo Tech. FRC, ²Tokyo Tech. IGSSE A. Abudukelimu¹, K. Kakushima², P. Ahmet¹, K. Tsutsui², A. Nishiyama², N. Sugii², K. Natori¹, T. Hattori¹, H. Iwai¹

Introduction

Conventional transport



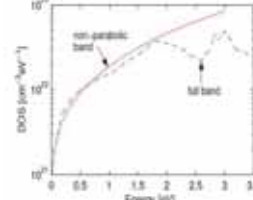
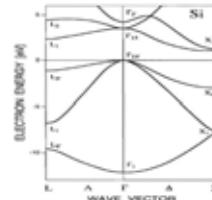
Ballistic transport



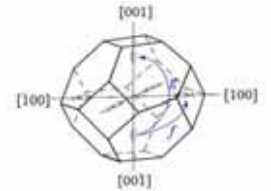
Aim: To understand influence of phonon generation on ballistic transport in channel.

Phonon Generation with Monte Carlo

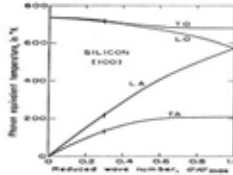
The analytical non-parabolic band approximation is used.



J. Appl. Phys., vol. 67, no. 6, pp. 2944-2954, 1990.



The intravalley and intervalley scattering are considered, all phonon scatterings are a inelastic scattering.



Phys.Rev., vol. 120, no. 6, pp. 2024-2032, 1960.

Phonon frequency

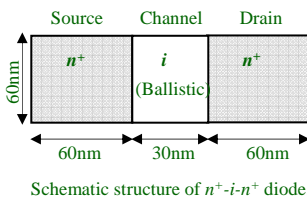
$$\omega_q = \omega_0 + v_s k + ck^2$$

Phonon generation

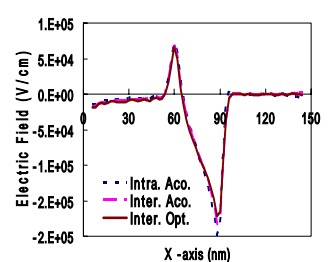
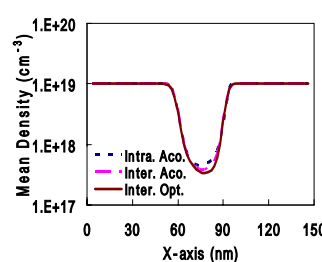
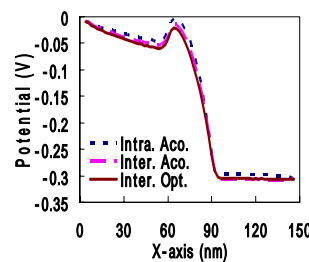
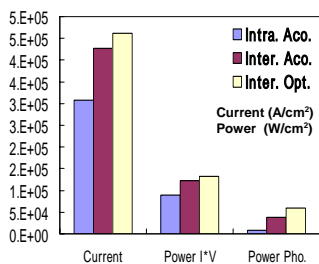
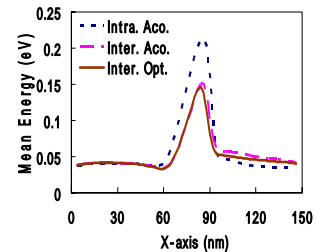
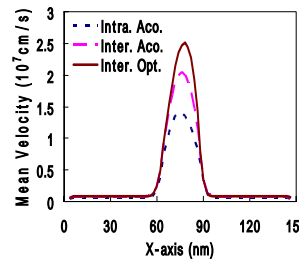
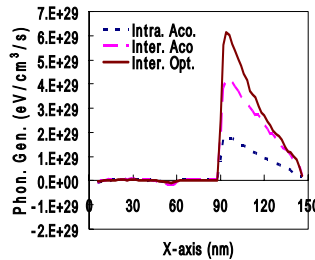
$$Q = \frac{A}{\Delta V \Delta t} \sum (\hbar\omega_{em} - \hbar\omega_{ab})$$

Results

Vd=0.3V



Schematic structure of n⁺-i-n⁺ diode.



Conclusion

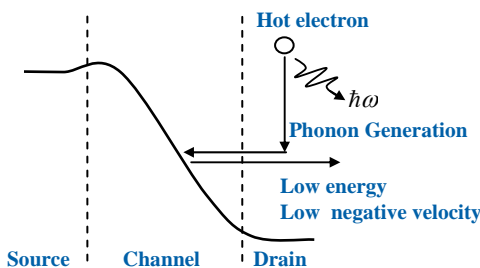
The possibility of rebound and absorption is the main influence on carriers transport.

Phonon generation is occur almost entirely in the drain, beyond the peak of electric field.

Phonon generation of hot electron in the drain strongly influence on ballistic transport in the channel.

The mean velocity of electron in the channel will be increase if the phonon generation of hot electron is dominant in the drain region.

The phonon generation region extends deep into the drain several mean free paths.



Schematic diagram showing the phonon generation of hot electrons.