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Effect of Surface-optical Phonons on the Charge Transport in Wrap-gated Semiconducting Nanowire Field-effect Transistors ANIRUDDHA KONAR, TIAN FANG, DEBDEEP JENA, University of Notre Dame — Surface phonons (SO-phonons) arise at the boundary of two different dielectric mediums. Though the effect of electron-surface phonon scattering on low-filed charge transport has been studied extensively for thin Si-MOSFET [1] and graphene [2], its effect on the 1D nanowire devices has not studied so far. Vibrating diploes in polar gate-dielectric induces a time-varying potential inside the nanowires. The frequencies of these time-varying fields have been calculated by implementing electrostatic boundary conditions at different interfaces of nanowire-dielectric-metal system. Our calculation shows that the electron-SO phonon interaction strength decays exponentially from the gate-nanowire interface towards the nanowire axis. Electron-SO phonon scattering rate has been calculated using Boltzmann transport equation under relaxation time approximation. We find that for thin nanowires (radius 1-20 nm), electron-SO phonon scattering rate is comparable to other dominant scattering mechanisms (such as impurity and bulk optical phonon scatterings) and reduces carrier mobility significantly. Calculating surface-phonon limited mobility of Si nanowires on various available common dielectrics, we have predicted the optimum choice of gate-dielectrics for nanowire-based electronic devices.

[1] M. V. Fischetti et. al J. Appl. Phys. 90 4581 (2001).
[2] A. Konar *et. al.* arXiv: 0902.0819.

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