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Modeling Random Dopant Fluctuation Effects in Nanoscale Tri-Gate MOSFETs JOSHUA OGDEN, ABDUSSAMAD MUNTAHI, KRISHNA YALAVARTHI, SHAIKH AHMED, Southern Illinois University — The tri-gate FET has been hailed as the biggest breakthrough in transistor technology in the last 20 years. The increase in device performance (faster switching, low power, improved short channel effects, etc.), coupled with the reduction in device size, would allow for huge gains in the electronics industry. In this work, an atomistic quantum-corrected Monte Carlo 3-D device simulator was used to not only investigate the validity of these claims, but also how quantum size quantization and random dopant fluctuation (RDF) affect the tri-gate FET performance and how to curb these issues. The main findings are as follow: 1) carrier scattering leads to ON current degradation of ~30% and hence cannot be ignored; 2) deviations in threshold voltage due to random channel doping are smaller in the tri-gate FET; 3) RDF due to the source/drain discreteness can be engineered by adjusting the source/drain junction depth. With randomness reduced, the overall performance should increase when used in ICs, where consistency in device characteristics is essential.

Krishna Yalavarthi
Southern Illinois University

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