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Corrections to "On the Ballistic Injection Velocity in Deeply Scaled MOSFETs"

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***Index Terms*—III-V MOSFETs, injection velocity, virtual source (VS).**

In [1], we showed that the velocity deduced by analyzing transistor I–V data with the virtual-source transistor model [2] is not always the velocity at the top of the energy barrier between the source and channel. Reference [1, Appendix] presented a qualitative explanation for why this discrepancy is more pronounced in Si MOSFETs than in III–V MOSFETs. This note points out an error in [1] but does not change the qualitative argument.

The discussion in [1, Appendix] focused on screening in nanoscale MOSFETs. Reference [1, (A.1)] was the Poisson equation, and $n(x)$ was the 3-D carrier density per cubic centimeter. Reference [1, (A.2)] should actually be the 2-D carrier density n_S per square centimeter. To first order, the 3-D electron density $n(x)$ is the areal electron density $n_{\text{2-D}}(x)$ divided by the channel body thickness t_{Si}, i.e., $n(x) = n_{\text{2-D}}(x)/t_{\text{Si}}$. The result is that the characteristic screening length in [1, (A.3)] should be written as $L_D = \sqrt{\varepsilon_s \pi \hbar^2 t_{\text{Si}}/q^2 m^*}$. As discussed in [1], a smaller effective mass m^* results in a longer characteristic length L_D, which leads to the ToB being located deeper in the channel, which produces a smaller n_{ToB} under high V_{DS} as discussed in [1] for III–V HEMTs.

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References

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[2] A. Khakifirooz, O. M. Nayfeh, and D. Antoniadis, "A simple semiempirical short-channel MOSFET current–voltage model continuous across all regions of operation and employing only physical parameters," *IEEE Trans. Electron Devices*, vol. 56, no. 8, pp. 1674–1680, Aug. 2009.

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