Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

Modeling of Phonon-assisted Zener Tunneling in Indirect Semiconductors WILLIAM VANDENBERGHE, K.U.Leuven / imec, BART SORÉE, imec, MASSIMO FISCHETTI, U.T.Dallas, WIM MAGNUS, Univ. Antwerpen / imec, GUIDO GROESENEKEN, K.U.Leuven / imec — With the scaling in the semiconductor device dimensions, Zener tunneling has become an important source of leakage in conventional MOSFET devices but it could also provide drive current for a novel type of tunnel transistor. A good understanding of the process of Zener tunneling is therefore required and present-day one-dimensional semi-classical models fall short of explaining tunneling in devices with potential profiles with a pronounced two-dimensional shape. We have developed a formalism to calculate the phonon-assisted current under a given three dimensional external potential profile. The current is calculated from the transition probability for an electron to go from the valence to the conduction band. The transition probability is determined from the spectral functions corresponding to the valence and the conduction band. In the presence of a one-dimensional uniform low electric field, the Kane model is recovered. An example of the formalism is given for the case of an abrupt p-n diode and compared with existing semi-classical models. It is seen that the uniform field model is actually better than the WKB model but that none of the semi-classical models give good results at low bias conditions.

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Date submitted: 02 Dec 2010 Electronic form version 1.4