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THE DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE, ECE DIVISION

Presents the Spring 2012 EECS Seminar Series

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"Physics Based Modeling of Nanoscale Multigate MOSFETs"

Thursday, February 16, 2012 11:00 a.m. HEC 450

Abstract

a) Modeling of Nanoscale DG and Circular Gate MOSFETs Using Conformal Mapping Techniques

A new technique for 2D compact modeling of short-channel, nanoscale double gate (DG) MOSFETs is presented. In low-doped devices working in the subthreshold regime, the potential distribution is dominated by the inter-electrode capacitive coupling between the body contacts. This 2D potential is determined by a precise solution of the Laplace equation for the device body using the technique of *conformal mapping*. Near threshold, where the spatial inversion charge becomes important, a self-consistent solution is applied for the important region around the barrier maximum. In sufficiently strong inversion, the electronic charge will dominate the potential profile in central parts of the channel. For this case, an analytical solution of the 1D Poisson's equation is used. The results are compared with numerical simulations.

b) Unified Isomorphic Modeling of Multigate MOSFETs

A compact analytical model is presented for the 3D electrostatics of square gate, rectangular gate, and trigate MOSFETs, and FinFETs. The model is based on solutions of the 3D Laplace equation in subthreshold and Poisson's equation in strong inversion. Suitable 2D *isomorphic functions* are utilized to describe the potential distributions in the cross sections perpendicular to the source-drain axis. High precision is made possible by utilizing auxiliary boundary conditions obtained from a conformal mapping analysis. Based on the electrostatics, the drain current and the intrinsic capacitances can be calculated in the full range of bias voltages. The model compares well with numerical calculations obtained from the ATLAS device simulator.

Biography

Dr. Tor A. Fjeldly received the Ph.D. degrees in Solid-state/semiconductor physics from Brown University, Providence, RI. He was a postdoctoral researcher at Max-Planck-Institute for Solid-State Physics, Stuttgart, Germany. In 1983, he joined the Norwegian University of Science and Technology as a professor. Dr. Fieldly holds Adjunct Positions in University of Oslo and UNIK – Inter-University Graduate Center, Norway. He also held visiting positions in University of Minnesota, University of Virginia, Rensselaer Polytechnic Institute, University of Rovira i Virgili, Tarragona, Spain, UCM and UCF. Dr. Fjeldly's current research interests are Novel semiconductor device technology – modeling and simulation of nanoscale, multigate MOSFETs and of III-V semiconductor HEMT devices, for application in circuit simulation. The research is funded by European Union and by the Norwegian Research Council.

Dr. Fjeldly has authored and coauthored more than 200 scientific and technical works, including 10 books (3 co-authored and 7 co-edited) and 11 book chapters. He is Co-Editor of the International Journal of High Speed Electronics and Systems and of the book series Selected Topics in Electronics and Systems, both with World Scientific Publishers (Singapore).

Dr. Fjeldly has been coordinator and partner in numerous national and international (EU and US) funded projects in semiconductor device research, has been member of many program and organizing committees of international conferences and workshops, and has been a reviewer for a large number of international scientific/technical journals and conferences. He is Fellow of IEEE and member of the Norwegian Academy of Technical Sciences.

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