

SEMINAIRE

(de 13 h à 14 h, amphithéâtre, Bât. INP, MINATEC,
ouvert aux chercheurs des autres laboratoires)

Jeudi 19 juin 2008

“I-MOS (Impact Ionization MOSFET): From the Single Device
to the Circuit”

par Frédéric MAYER

Abstract: The subthreshold slope, S , is limited in conventional MOSFETs to 60mV/dec at room temperature due to the diffusion phenomenon. This feature is a major drawback for the reduction of the supply voltage. To bypass this limitation, a new device has been proposed in 2002 by Gopalakrishnan [1]: the Impact Ionization MOSFET (I-MOS). Using impact ionization instead of diffusion to provide carriers leads to very sharp subthreshold slopes (down to 2 mV/dec. as we demonstrated experimentally in 2006 [2]).

In this presentation, we will first describe this device and its operation through TCAD simulations. We will also present the fabrication process steps which have enabled us to demonstrate 2 mV/dec subthreshold slope. Moreover our approach allows the co-integration of CMOS and I-MOS devices.

In order to determine the advantages and the drawbacks of the I-MOS-based logic gates (invertors...) and circuits, we propose an analytical physical based compact model which enables circuit simulations. Before closing the talk, the reliability issues of the I-MOS will be analyzed.

[1] K. Gopalakrishnan, P.B. Griffin and J. Plummer, “I-MOS : A Novel Semiconductor Device with a Subthreshold Slope lower than kT/q ”, IEDM 2002, p289-292.

[2] F. Mayer et al, “Co-integration of 2 mV/dec Subthreshold Slope Impact Ionization MOS (I-MOS) with CMOS”, ESSDERC, september 2006, p303-306.

Frédéric Mayer was born in Frankenthal, Germany in 1982. He received the M.Sc. degree from the “Ecole Nationale Supérieure de Physique de Grenoble (ENSPG)” in 2005, Grenoble, France. He is currently pursuing his Ph.D. degree with the CEA-Laboratoire d’Electronique et Technologie de l’Information (LETI), Grenoble, France. His work is dedicated to the study of the Impact Ionization MOSFET (I-MOS), including a theoretical part comprising TCAD simulations, analytical and compact modeling and a technological part comprising realization and characterization of the I-MOS. His supervisors are Cyrille Le Royer (CEA) and Gilbert Vincent (UJF) (up to April 2007 his supervisor at LETI was Laurent Clavelier).

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