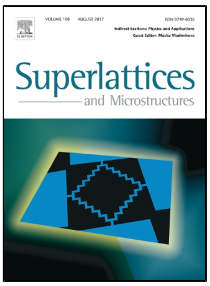
Accepted Manuscript



Investigation of Inversion, Accumulation and Junctionless mode Bulk Germanium FinFETs

Vasanthan Thirunavukkarasu, Jaehyun Lee, Toufik Sadi, Vihar P. Georgiev, Fikru-Adamu Lema, Karuppasamy Pandian Soundarapandian, Yi-Ruei Jhan, Shang-Yi Yang, Yu-Ru Lin, Erry Dwi Kurniawan, Yung-Chun Wu, Asen Asenov

PII:	S0749-6036(17)31418-0
DOI:	10.1016/j.spmi.2017.07.020
Reference:	YSPMI 5130
To appear in:	*Superlattices and Microstructures*
Received Date:	09 June 2017
Accepted Date:	07 July 2017

Please cite this article as: Vasanthan Thirunavukkarasu, Jaehyun Lee, Toufik Sadi, Vihar P. Georgiev, Fikru-Adamu Lema, Karuppasamy Pandian Soundarapandian, Yi-Ruei Jhan, Shang-Yi Yang, Yu-Ru Lin, Erry Dwi Kurniawan, Yung-Chun Wu, Asen Asenov, Investigation of Inversion, Accumulation and Junctionless mode Bulk Germanium FinFETs, *Superlattices and Microstructures* (2017), doi: 10.1016/j.spmi.2017.07.020

Investigation of Inversion, Accumulation and Junctionless mode Bulk Germanium FinFETs

Vasanthan Thirunavukkarasu [a,b,c], Jaehyun Lee [b], Toufik Sadi [b], Vihar P. Georgiev [b], Fikru-Adamu Lema [b], Karuppasamy Pandian Soundarapandian [b], Yi-Ruei Jhan [a], Shang-Yi Yang [a], Yu-Ru Lin [a], Erry Dwi Kurniawan [a,b], Yung-Chun Wu [a,*] and Asen Asenov [c,d]

[a] Department of Engineering and System Science, National Tsing Hua University, Hsinchu 300, Taiwan
[b] Nano Science and Technology Program, Taiwan International Graduate Program, Academia Sinica, Taipei 115, Taiwan and National Tsing Hua University, Hsinchu 300, Taiwan
[c] Device Modeling Group, School of Engineering, University of Glasgow, Glasgow, Scotland, UK
[d] Gold standard Simulations Ltd. (now part of Synopsys), Glasgow G3 7JT, Scotland, UK

Abstract—The characteristic performance of n-type and p-type inversion (IM) mode, accumulation (AC) mode and junctionless (JL) mode, bulk Germanium FinFET device with 3-nm gate length (L_G) are demonstrated by using 3-D quantum transport device simulation. The simulated bulk Ge FinFET device exhibits favorable short channel characteristics, including drain-induced barrier lowering (DIBL<10mV/V), sub threshold slope (SS~64mV/dec.). Electron density distributions in ON-state and OFF-state also show that the simulated devices have large I_{ON}/I_{OFF} ratios. Homogenous source/drain doping is maintained and only the channel doping is varied among different operating modes. Also, a constant threshold voltage $|V_{TH}|$~0.31V is maintained. Moreover, the calculated quantum capacitance (C_Q) values of the Ge nanowire emphasizes the importance of quantum confinement effects (QCE) on the performance of the ultra-scaled devices.

***Keywords*— Germanium, junctionless, FinFETs, 3D TCAD simulation, quantum confinement effects.**

[*] **Corresponding author**:

Prof. Yung-Chun Wu
Department of Engineering and System Science, National Tsing Hua University, 101, section 2 Kuang Fu Road, Hsinchu 30013, Taiwan.
TEL: +886-3-5715131 ext. 34287 FAX: +866-3-5720724
E-mail: ycwu@ess.nthu.edu.tw
Mailing address:
R408 ESS Building, National Tsing Hua University, 101, section 2 Kuang Fu Road, Hsinchu 30013, Taiwan.