



J. Lorenz (ed.)

*3-Dimensional
Process Simulation*

Springer-Verlag Wien New York

J. Lorenz
Fraunhofer-Institut für Integrierte Schaltungen
Bauelementetechnologie
Schottkystrasse 10
D-91058 Erlangen

This work is subject to copyright.
All rights are reserved, whether the whole or part of the material is concerned,
specifically those of translation, reprinting, re-use of illustrations, broadcasting,
reproduction by photocopying machines or similar means, and storage in data banks.

© 1995 Springer-Verlag/Wien
Softcover reprint of the hardcover 1st edition 1995

Typesetting: Camera ready by authors

Printed on acid-free and chlorine free bleached paper

With 164 Figures

ISBN-13:978-3-7091-7430-2 e-ISBN-13:978-3-7091-6905-6
DOI: 10.1007/978-3-7091-6905-6

EDITORIAL

This volume contains the Proceedings of the International “Workshop on 3D Process Simulation” which was held at the Campus of the University of Erlangen-Nuremberg in Erlangen on September 5, 1995, in conjunction with the 6th International Conference on “Simulation of Semiconductor Devices and Processes” (SISDEP '95). The workshop follows the International “Workshop on Technology CAD Systems” which was held at the Technical University of Vienna in conjunction with SISDEP '93.

Two-dimensional process simulation has achieved a certain degree of maturity. In consequence, well established program systems are available both via commercial software houses and from research institutes or universities. However, considerable improvements are still required in terms of the accuracy of the models used and the algorithms implemented, especially for adaptive meshing in case of time-dependent device geometries. In contrast to this, three-dimensional process simulation is a newly emerging field in which most efforts are dedicated to necessary basic developments. Technological demands from novel ULSI technologies require the availability of advanced three-dimensional process simulation tools to provide appropriate input to three-dimensional device simulation and, in this way, to allow for the support of ULSI device development and optimization. Major research and development activities dedicated to three-dimensional process simulation are presently being carried out around the world. In consequence, it can be expected that three-dimensional process simulation will prove to be a key component in advanced TCAD systems within the next few years.

Within the “Workshop on 3D Process Simulation”, an overview of the activities being carried out in Japan, the USA, and Europe was given. The workshop consisted of ten invited presentations, among which four were from leading semiconductor companies, six were from research Centers of Excellence. Nine of these presentations are included in this book. In addition, a panel discussion on “Future Requirements and Trends in Multidimensional TCAD Simulation” was held during the Workshop.

The proceedings were printed from the authors' camera-ready manuscripts. I would like to express my sincere appreciation to the authors for their high quality contributions, their cooperation and efforts. Furthermore, I would like to thank my colleagues at FhG-IIS-B, especially F. Meyer, S. List, M. Schäfer, and C. Scordo, for their assistance in finalizing the proceedings and organizing the Workshop.

Jürgen Lorenz
Editor

September 1995

SUPPORTING ORGANIZATIONS

Bayerische Verwaltung der Staatlichen Schlösser, Gärten und Seen
 Bayerisches Staatsministerium für Wirtschaft, Verkehr und Technologie
 VDE/VDI-Gesellschaft Mikroelektronik (GME)
 IEEE Electron Devices Society
 IEEE German Section
 Informationstechnische Gesellschaft (ITG)
 Siemens AG
 Universität Erlangen-Nürnberg

SISDEP CONFERENCE COMMITTEE

G. Baccarani	Università di Bologna	ITALY
K. de Meyer	IMEC	BELGIUM
W. Fichtner	ETH Zürich	SWITZERLAND
M. Fukuma	NEC	JAPAN
H. Jacobs	Siemens	GERMANY
S. Laux	IBM	USA
C. Lombardi	SGS-Thompson	ITALY
P. Mole	BNR Europe	UNITED KINGDOM
M. Orłowski	Motorla	USA
A. Poncet	CNET/CNS	FRANCE
H. Ryssel	Universität Erlangen-Nürnberg	GERMANY
W. Schilders	Philips	THE NETHERLANDS
S. Selberherr	Technische Universität Wien	AUSTRIA
T. Toyabe	Hitachi	JAPAN
H. Van der Vorst	Rijksuniversiteit Utrecht	THE NETHERLANDS

SISDEP LOCAL ORGANIZING COMMITTEE

M. Ebner	S. List	P. Pichler	M. Schäfer
T. Klausner	F. Meyer	H. Ryssel	C. Scordo

Table of Contents

Three-Dimensional Topography Simulator: 3D-MULSS and Its Applications	1
<i>M. Fujinaga and N. Kotani</i>	
ULSI Laboratory, Mitsubishi Electric Corporation, Hyogo 664, JAPAN	
A Three-Dimensional Process Simulation using Advanced SMART-P program	30
<i>H. Umimoto, S. Odanaka, and A. Gohda</i>	
Semiconductor Research Center, Matsushita Electric Industrial Co., Osaka 570, JAPAN	
3-D Topography Simulation Using Surface Representation and Central Utilities	57
<i>A. R. Neureuther, R. H. Wang, J. J. Helmsen, J. F. Seffler, E. W. Scheckler, R. Gunturi, and R. Winterbottom</i>	
Dept. of Electrical Engineering and Computer Sciences, UC Berkeley, USA	
Three Dimensional Simulation of Thermal Processes	77
<i>M. E. Law and S. Cea</i>	
Dept. of Electrical Engineering, University of Florida, Gainesville, USA	
3D Process Simulation at IEMN/ISEN	95
<i>B. Baccus, S. Bozek, V. Senez, and Z. Z. Wang</i>	
IEMN Département ISEN, Lille Cédex, FRANCE	
3D Simulation of Topography and Doping Processes at FhG	109
<i>J. Lorenz^a, E. Bär^a, A. Bourenkov^a, W. Henke^b, K. Tietzel^a, and M. Weiß^b</i>	
^a Fraunhofer-Institut für Integrierte Schaltungen, Erlangen, Germany	
^b Fraunhofer-Institut für Siliciumtechnologie, Itzehoe, Germany	
3D TCAD at TU Vienna	136
<i>E. Leitner, W. Bohmayr, P. Fleischmann, E. Strasser, and S. Selberherr</i>	
Institute for Microelectronics, TU Vienna, AUSTRIA	
Multi-Dimensional TCAD: The PROMPT/DESSIS Approach	162
<i>M. Westermann^a, T. Feudel^b, N. Strecker^b, S. Gappisch^b, A. Höfler^b, and W. Fichtner^{a,b}</i>	
^a ISE Integrated Systems Engineering AG, Zürich, Switzerland	
^b Swiss Federal Institute of Technology, Integrated Systems Laboratory, Zürich, Switzerland	

3D Process Simulation Requirements And Tradeoffs From Industrial Perspective	178
<i>M. Orłowski</i> Advanced Products and Development Laboratory, Motorola Inc., Austin, Texas, USA	
Author Index	196