

SIMULATION ON PARAMETER AND
CHARACTERISTICS EXTRACTION BETWEEN TWO
SIMULATION PACKAGES (SYNOPTIS AND PSPICE)

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2007

**SIMULATION ON PARAMETER AND CHARACTERISTICS
EXTRACTION BETWEEN TWO SIMULATION PACKAGES
(SYNOPTIS AND PSPICE)**

by

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Report submitted in partial fulfillment
of the requirements for the degree
of Bachelor of Engineering



MARCH 2007

ACKNOWLEDGEMENT

First and foremost, I want to thank to Allah S.W.T because with the courage and patient that have been given to me, I have manage to complete and finish my final year project as well as my report. In completing this project and report I faced many difficulties and experiences but finally I succeeded and I am satisfied with all the courage and strength that I have put to finish up this project and report.

Very special thanks to my supervisor Puan Noraini Othman for her guidance, encouragement and contribution for this project. She gave me useful advices, motivates me when I encountered problems and willingly shares knowledge regarding this project. I am really thankful for her full support for the time along.

Thank you very much to my lovely friends that helps me a lot for the success of this final and report. They shared their knowledge and gave me a big help in the project. Also thank you to my family that support and encourage me to finish the project although it was quite hard for me. Finally with the helps, spirits and courage they gave me I had overcome all the difficulties and problems I faced.

Finally, a very sincere appreciation extends to Universiti Malaysia Perlis that give me chance to complete my bachelor of engineering studies here. All knowledge and experiences that I have learn here are very useful when we are involve in the real engineering world.

APPROVAL AND DECLARATION SHEET

This project report titled Simulation on Parameter and Characteristics Extraction between Two Simulation Packages (Synopsys and PSpice) was prepared and submitted by Nor Aznin binti Sakrani (Matrix Number: 031010355) and has been found satisfactory in terms of scope, quality and presentation as partial fulfillment of the requirement for the Bachelor of Engineering (Microelectronic Engineering) in Universiti Malaysia Perlis (UniMAP).

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March 2007

SIMULASI KE ATAS PENGEKSTRAKAN PARAMETER DAN CIRI ANTARA DUA PAKEJ SIMULASI (SYNOPTSYS DAN PSPICE)

ABSTRAK

Perkembangan dan peningkatan yang mendadak dalam teknologi silikon semenjak 20 tahun lalu telah membuka satu jalan yang luas dan besar dalam bidang teknologi maklumat di mana ia telah mengubah cara hidup dan pemikiran manusia. Secara khususnya, perkembangan dalam teknologi ini adalah dengan bantuan daripada perisian "TCAD". Dalam projek ini, "Synopsys Taurus Workbench" bersama "TSUPREM-4" dan "Medici" digunakan sebagai litar pengamiran maya yang mensimulasikan proses pembuatan semikonduktor dan dapat meramalkan cirian sesuatu peranti. Perisian TCAD PSpice kemudiannya digunakan untuk simulasi litar. Objektif projek ini adalah untuk memadankan kedua-dua program ini dalam pengekstrakan parameter dan ciri. Pertama, suatu peranti awal NMOS, panjang *gate* 1.5 μ m, dengan nilai kepekatan substrat dan ketebalan *gate* oksida yang berbeza-beza dihasilkan menggunakan TSUPREM-4 dari Synopsys. Pengekstrakan parameter dan ciri kemudiannya dijalankan menggunakan Medici. Selanjutnya, dengan menggunakan perisian PSpice, simulasi peringkat litar direka bentuk dan ciri elektrik diperolehi. Parameter untuk diekstrak adalah voltan *threshold* V_{th} . Untuk kepekatan *dopant* boron $N_B=10^{15}$ atoms/cm³, peratus perbezaan V_{th} untuk pelbagai ketebalan *gate* oksida T_{ox} adalah di antara 2.45% sehingga 12.49%, manakala untuk $N_B=10^{18}$ atoms/cm³, peratus perbezaan V_{th} adalah di antara 0.15% sehingga 3.04%. Keputusan ini menunjukkan purata peratus perbezaan untuk kepekatan *dopant* $N_B=10^{15}$ atoms/cm³ lebih tinggi daripada purata peratus perbezaan untuk kepekatan *dopant* $N_B=10^{18}$ atoms/cm³. Secara amnya, pencirian elektrik dan parameter boleh diekstrak daripada dua pakej simulasi ini-Synopsys dan PSpice, dan kedua-duanya boleh diterima sebagai perisian reka cipta litar terkamir.

ABSTRACT

The progress of silicon technologies in the last twenty years has traced the path to the unprecedented revolution of information technologies, which has changed everybody's lifestyles. Apparently, this has happened with the help from TCAD tools. In this project, Synopsys Taurus Workbench including TSUPREM-4 and Medici is used as a virtual IC factory that simulates semiconductor manufacturing processes and predicts device characteristics. PSpice TCAD tool is used afterwards for circuit simulation. The objective of this project is to match these two program packages in the area of parameter and characteristics extraction. First, an initial device of NMOS of gate length of $1.5\mu\text{m}$ with different values of substrate concentration and gate oxide thickness is created by using TSUPREM-4 from Synopsys. The extraction of the parameter and electrical characteristics is then carried out in Medici. Next, using PSpice TCAD tool, the circuit level for NMOS is designed and electrical characteristics are obtained. The parameter of interest to be extracted is the threshold voltage V_{th} . The results obtained from these two simulation packages are then compared and its percentage of different is analyzed. For dopant concentration of boron $N_{\text{B}}=10^{15}\text{atoms/cm}^3$ the percentage of different of V_{th} for the varied gate oxide thickness T_{ox} is between 2.45% until 12.49%, while for $N_{\text{B}}=10^{18}\text{atoms/cm}^3$ percentage of different of V_{th} is between 0.15% until 3.04%. The results show that the average percentage of different for dopant concentration $N_{\text{B}}=10^{15}\text{atoms/cm}^3$ is higher than the average percentage of different for dopant concentration $N_{\text{B}}=10^{18}\text{atoms/cm}^3$. Generally, the electrical characteristics and parameters can be extracted from these two simulation packages-Synopsys and PSpice, and both can be accepted as the design tools for integrated circuits.

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