MOS-AK

Review&Outlook

Dr. Min Zhang
Dr. Wladek Grabinski

Arbeitskreis Modellierung von Systemen und Parameterextraktion
Modeling of Systems and Parameter Extraction Working Group

Organizer:

Sponsors:

MOS-AK Modeling Events 2020-2021

- 14th US MOS-AK Workshop, Silicon Valley (US) Dec. 2021
  in timeframe of IEDM and Q4 CMC Meetings
- 19th MOS-AK at ESSDERC/ESSCIRC, Grenoble (F) Sept.6, 2021
- 5th Sino MOS-AK Xi'an (CN), Aug. 2021
- FOSS TCAD/EDA at 5NANO2021, Kottayam (IN) April, 2021
- 3rd MOS-AK at LAEDC (MX), (online) April 18 2021
- 1st MOS-AK Asia/South Pacific, (online) Feb. 25-26, 2021
- FOSDEM CAD/EDA DevRoom, ULB, (B) Feb. 6-7, 2021
- IEEE EDS MQ Compact Modeling, Dec. 17 2020
- 13th US MOS-AK Workshop, Silicon Valley (US) Dec. 10-11, 2020
- MOS-AK Workshop, Giessen (D), Sept.29-30 - Oct.1, 2020
- 18th MOS-AK Workshop at ESSDERC/ESSCIRC, Sept. 14, 2020
- 2nd MOS-AK at LAEDC, Costa Rica, Febr.25, 2020

MOS-AK China history

1st compact model workshop

2nd compact model workshop

MOS-AK 上海 2016

MOS-AK 杭州 2017

MOS-AK 北京 2018

MOS-AK 成都 2019

MOS-AK China breakthrough 1

Question:

Prof. Yuehang Xu

from UESTC

Author Names	Website Link	Title
Dai, Kehan; Sang, Lei; Zhao, haojie; zhang, jie	https://onlinelibrary.wiley.com/doi/abs/10.1002/mop.32323	A modified T-type equivalent circuit model for stretchable microstrip line
Gao, Libo; Du, Chuanhua; Bu, Jianhui; Li, Jiangjiang; Ma, Quangang; Zhao, Fazhan; Gao, Jiantou; Li, Duoli; Zeng, Chuanbin; Zheng, Chao; Han, Zhengsheng; Luo, Jiajun	https://onlinelibrary.wiley.com/doi/10.1002/mop.32317	A transient ionizing radiation SPICE model for PDSOI MOSFET
Yan, Lixi; Li, Tianyu; Kallfass, Ingmar	https://onlinelibrary.wiley.com/doi/10.1002/mop.32119	Characterization and modeling of the reverse behavior of a vertical power MOSFET
Zhanfei, Chen; Sun, Lingling; Liu, Jun	https://onlinelibrary.wiley.com/doi/10.1002/mop.32208	A comparison of dynamic thermal characteristics of planar and Fin GaN HEMTs
Guo, Ao; Shang, Enming; Hu, Shao-Jian; Chen, Shoumian	https://onlinelibrary.wiley.com/doi/10.1002/mop.32217	TCAD-based statistical modeling methodology for nanoscale FinFET variability
Xie, Chengcheng; Yu, Gang; Zhang, Ziheng; Wang, Huanpeng; Li, Youda; Wu, Yunqiu; Guo, Yunchuan; min, xu; Xu, Yuehang	https://onlinelibrary.wiley.com/doi/10.1002/mop.32376	A microwave amplifier behavioral model capable of cascade simulation
Zhu, Guiqiang; chang, chen; Xu, Yuehang; Zhang, Ziheng; AL-saman, Amgad; Lin, Fujiang	https://onlinelibrary.wiley.com/doi/10.1002/mop.32404	A millimeter-wave scalable small-signal modeling approach based on FW-EM for AlGaN/GaN HEMT up to 110 GHz
Zhao, Ziyue; Lu, Yang; ma, xiaohua; Zhang, Hengshuang; Yi, ChuPeng; Wang, Yuchen; Hao, Yue	https://onlinelibrary.wiley.com/doi/10.1002/mop.32497	Highly accurate GaN HEMT model based on the Angelov model with error compensation

增加国内交流&国内外资源共享

1. BTI reliabilty model from institute (design for reliability)

2. GaN model extraction software from university

3. Python language based software from startup

MOS-AK China breakthough 2

"A Unified Physical BTI Compact Model in Variability-Aware DTCO Flow: Device Characterization and Circuit Evaluation on Reliability of Scaling Technology Nodes"的论文入选2021 VLSI Technology。微电子所博士生赵莹为第一作者，汪令飞副研究员、李泠研究员和刘明院士为通讯作者。

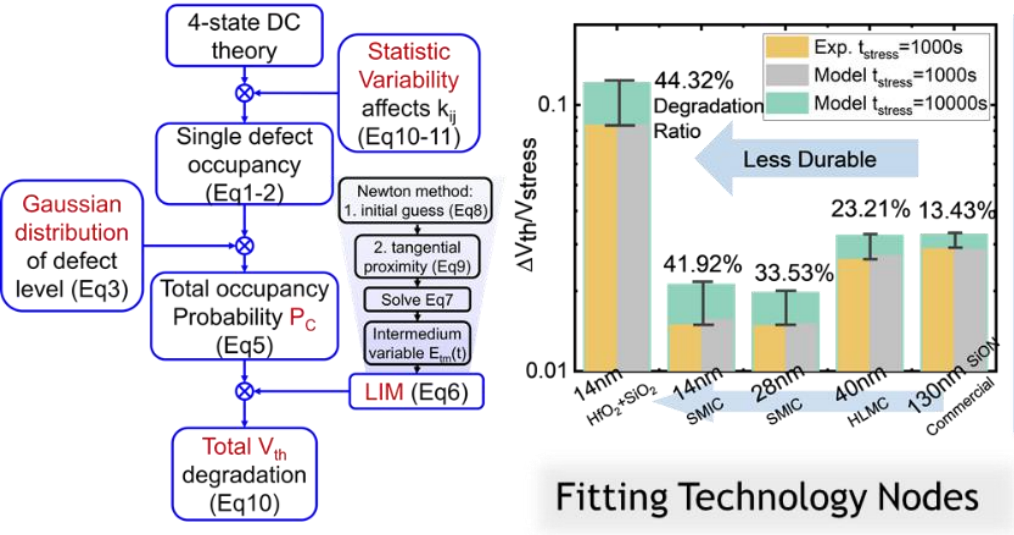


图1 基于4-state缺陷中心的BTI紧凑模型，可适用多种工艺节点并给出耐久性分析

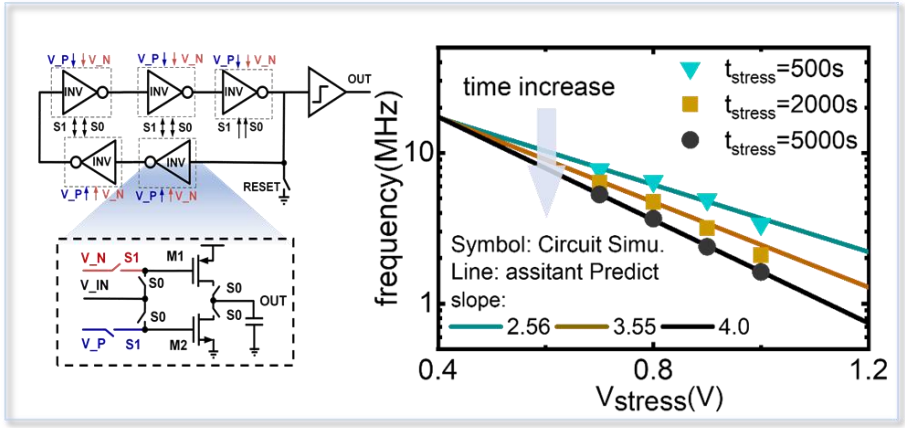
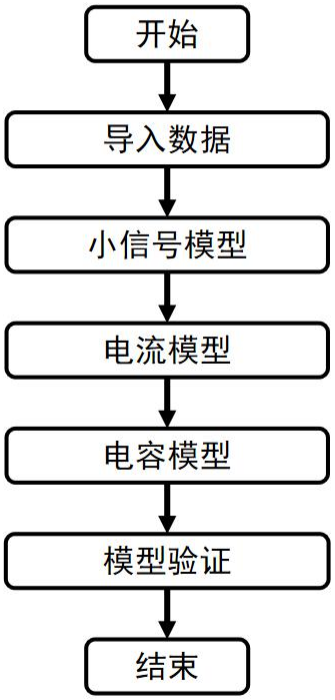


图2 嵌入了BSIM-CMG用于器件及电路老化性能的动态时间演化和预测分析

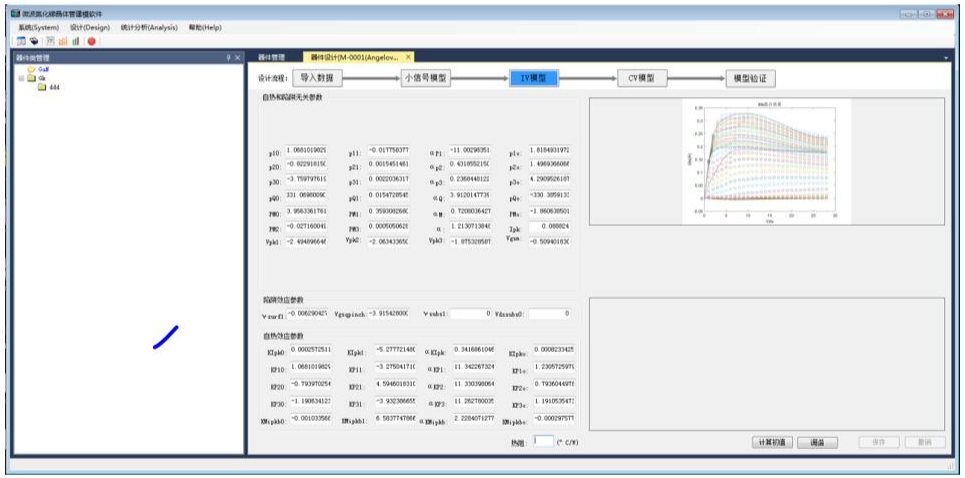
偏置温度不稳定(BTI)效应是集成电路(IC)器件可靠性的关键问题之一，该团队开发了一个统一的物理和统计紧凑模型，可以预测BTI对不同工艺节点的器件及电路（低至14nm）的影响，包含复杂的应力/恢复模式表征、超长期老化预测和工艺统计变量(TSV)的影响，实现cycle to cycle/device to device的可靠性评估。该模型基于2/4态的缺陷中心(DC)理论，针对缺陷的物理特性(如能级分布、占据概率等)建模。通过TCAD仿真验证和对鳍状场效应晶体管(FinFET)、平面晶体管等可靠性实验测试结果的校准，成功地嵌入了BSIM-CMG通用模型，用于器件及电路的动态时间演化和动态电压缩放分析。这种物理的、可变性的和具有耐久性感知的紧凑模型有潜力将VLSI可靠性设计技术协同优化(DTCO)流程提升到下一代技术节点。

电子科技大学 University of Electronic Science and Technology of China
MMT 微波毫米波电集成路与系统实验室 Microwave and Millimeter-wave Technology(MMT) Lab



模型参数提取流程

氮化镓晶体管模型参数提取软件



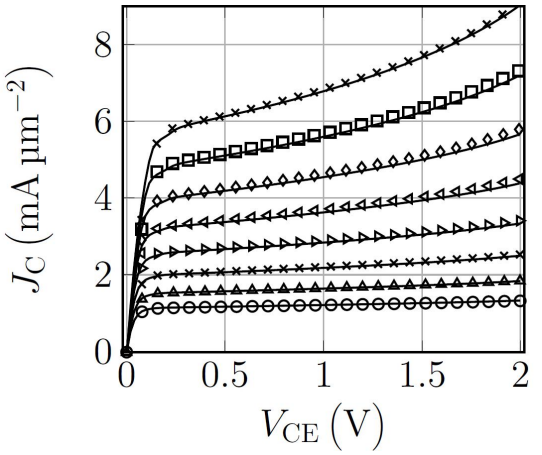
- 支持Focus测试系统数据导入；
- 界面简单、操作便捷；
- 每一步含自动参数提取；
- 支持ADS等软件的PDK自动生成。

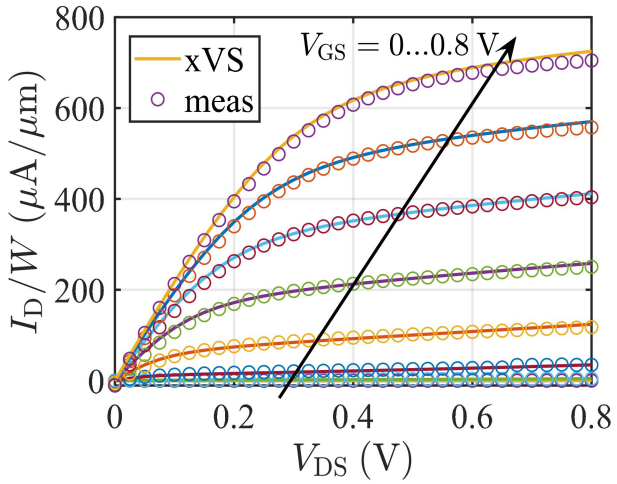
基于第三代半导体的设计应用也越来越广泛，需要好的PDK来减少芯片time to market（小而美是国内需要的，也是值得支持的）

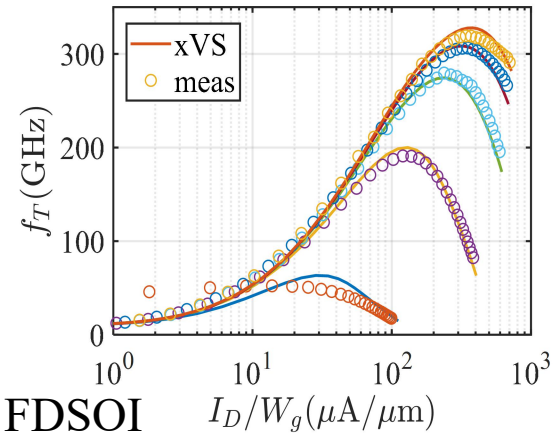
MOS-AK China breakthough 2

SemiMod – DMT

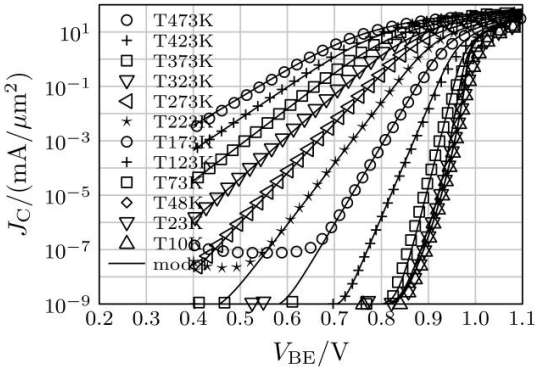
DMT is **python based**, which is very good for data handling. Regarding Python: Python is the most flexible and widely spread high-level programming language in the world, it has the most extensive set of open-source libraries for all kinds of purposes. Key libraries using are scipy, numpy and pandas.



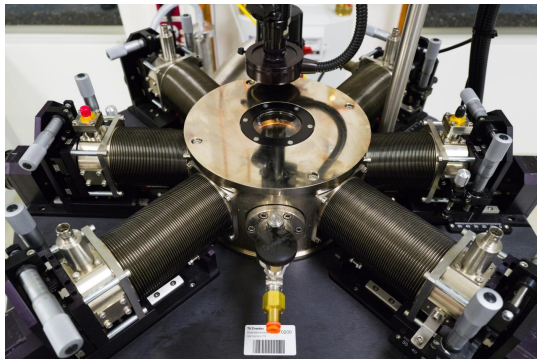




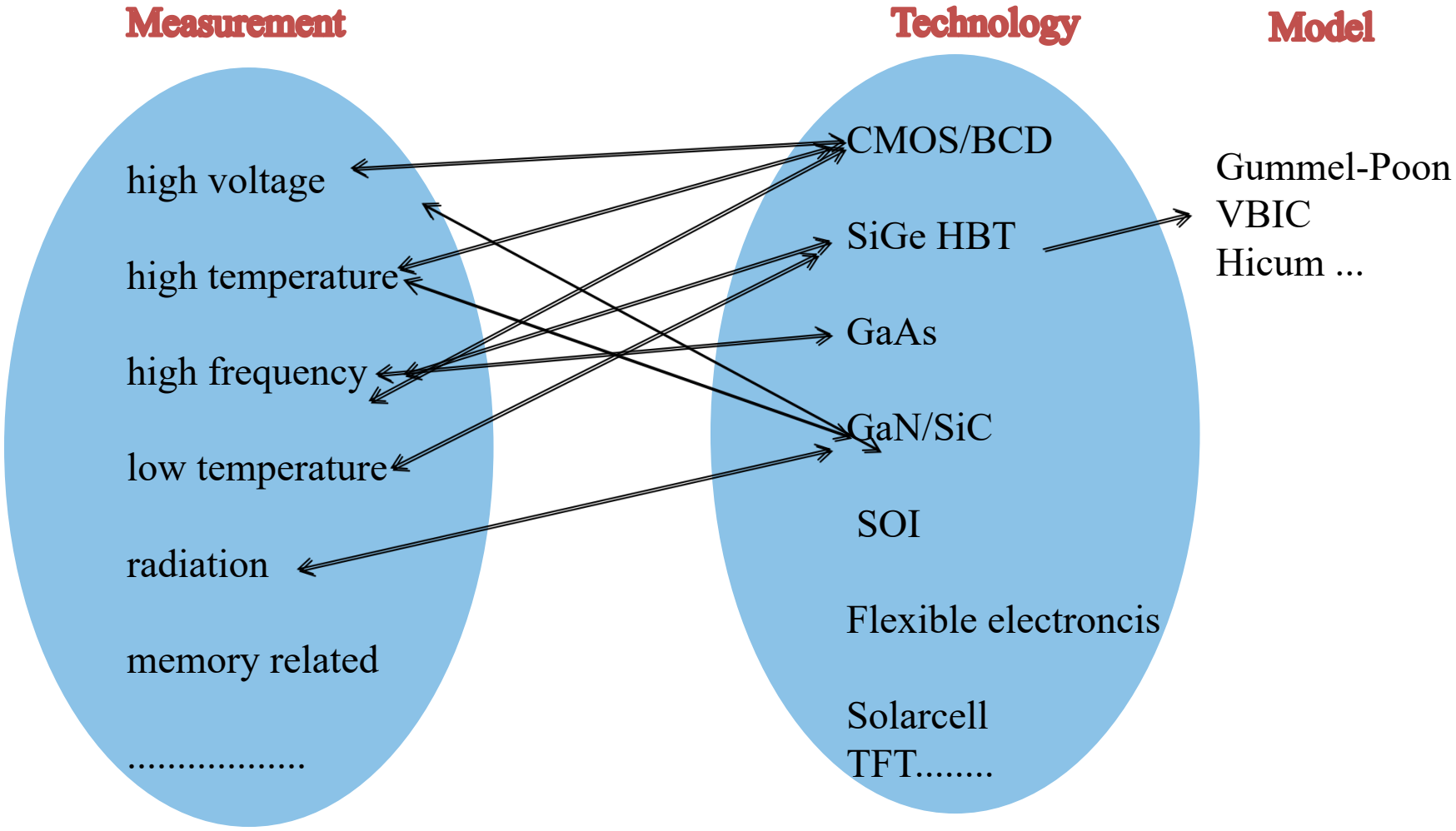
FDSOI



SiGe HBT from 10K to 473K



Everyone is with strong point or advantage, need more communication:



no one is expert for all fields

MOS-AK 2022 new outlook

1. Plan to give 30 -60 minutes for resource sharing session , open to all , welcome institute, university & start up to make presentation. Special resources or capability in the field of Measurement, Modeling, Device design , EDA tool innovation and so on. (MOS-AK 2022开始，组织1-3 个单位 展示有模型相关的特色资源或者技能）

2. Welcome all EDA/Design houses/Foundry to pass down request info related to the measurement, modeling, design related, which will be open to MOS-AK platform （欢迎半导体相关企业，把模型相关需求给到MOS-AK，让参与人员更了解市场和合作机会）

Wish you have a fruitful learning day &

more open minded after MOS-AK 西安