Session 32 - Modeling and Simulation - Modeling of Emerging Memory Systems
Wednesday, December 11, 9:00 a.m.
Continental Ballroom 6
Co-Chairs: N. Xu, Samsung
B. Gao, Tsinghua University

9:05 AM **32.1** Quantitative 3-D Model to Explain Large Single Trap Charge Variability in Vertical NAND Memory
Devin Verreck, Antonio Arreghini, Joao Bastos, Franz Schanovsky, Ferdinand Mitterbauer, Christian Kernstock, Markus Karner, Robin Degraeve, Geert Van den bosch, Arnaud Furnemont, imec, Global TCAD Solutions GmbH

We present a TCAD model that reproduces large single trap V_T-shifts (>100mV) in 3-D NAND through targeted charge placement based on linear response. With this model, we investigate worst-case V_T-shifts in terms of bias conditions and junction position and we outline a sampling strategy that allows to reproduce experimental distributions.

9:30 AM **32.2** A Comprehensive Modeling Framework for Ferroelectric Tunnel Junctions
Hsin-Hui Huang, Tzu-Yun Wu, Yueh-Hua Chu, Ming-Hung Wu, Chien-Hua Hsu, Heng-Yuan Lee, Shyh-Shyuan Sheu, Wei-Chung Lo, Tuo-Hung Hou, National Chiao Tung University, Industrial Technology Research Institute

A modeling framework for ferroelectric tunnel junctions(FTJs) that considers nonpolar interfacial layers(ILs), multi-domain polarization, and complete ferroelectric/capacitive/tunneling currents is proposed. This FTJ model explains read and write operations of various switching polarities, and provides optimization guidelines where IL location and effective thickness ratio between ferroelectric and IL are most critical.

9:55 AM **32.3** Modeling of Switching Speed and Retention Time in Volatile Resistive Switching Memory by Ionic Drift and Diffusion
Wei Wang, Erika Covi, Yu-Hsuan Lin, Elia Ambrosi, Daniele Ielmini, Politecnico di Milano, National Chiao Tung University

We investigated the switching dynamics of Ag filament based volatile switching devices through the switching-on speed and retention time. The surface ionic drift and diffusion mechanism are proposed and confirmed by experimental data. The ionic mobility and diffusivity can be theoretically connected through Einstein relation.

10:20 AM **32.4** A Physics-based Model of RRAM Probabilistic Switching for Generating Stable and Accurate Stochastic Bit-streams
Yudi Zhao, Wensheng Shen, Peng Huang, Weijie Xu, Mengqi Fan, Xiaoyan Liu, Jinfeng Kang, Peking University

A physics-based probabilistic switching model for RRAM stochastic number generator (SNG) is developed to quantify the stochastic bit-streams and evaluate the accuracy of stochastic computing. The model can be used to design the operation scheme of SNG and choose appropriate bit-stream length to achieve target system performance.

10:45 AM **32.5** DNN+NeuroSim: An End-to-End Benchmarking Framework for Compute-in-Memory Accelerators with Versatile Device Technologies

Xiaochen Peng, Shanshi Huang, Yandong Luo, Xiaoyu Sun, Shimeng Yu, Georgia Institute of Technology

DNN+NeuroSim is an integrated framework to benchmark compute-in-memory accelerators for deep neural networks, with hierarchical design options from device-level, circuit-level and up to algorithm-level. With a python wrapper (Pytorch and Tensorflow), this framework supports automatic algorithm to hardware mapping, and evaluates both chip-level performance and inference accuracy with hardware constraints.