



Call for Papers  
for a Special Issue of  
IEEE Transactions on Electron Devices

on

**“New simulation methodologies for next-generation TCAD tools”**

Technology Computer Aided Design is used to simulate semiconductor processes and devices, a field which has become increasingly complex and heterogeneous. Processing of integrated circuits requires nowadays over 400 process steps, and the resultant devices often have a complicated 3D structure and contain various materials. The full device behavior can only be understood by considering effects on all length scales from atomistic (interfaces, defects etc.) over nanometric (quantum confinement, non-bulk properties etc.) to full chip dimensions (strain, heat transport etc.), and time scales from femtoseconds to seconds. Voltages, currents and charges have been scaled to such low levels that electronic noise, statistical effects and process variations have a strong impact. Devices based on new materials (e.g. 2D crystals) and physical principles (ferroelectrics, magnetic materials, qubits etc.) challenge standard TCAD approaches. While the simulation methods developed by the physics community can describe the basic device behavior, they often lack important simulation capabilities like, for example, transient simulations or integration with other TCAD tools and are too slow for daily use. Due to the complexity of semiconductor technology, it becomes more and more difficult to assess the impact of a change in processing or device structure on circuit performance by looking at a single aspect of an isolated device under idealized conditions. Instead a TCAD tool chain is required that can handle realistic device structures embedded in a chip environment. New methodologies are required for all aspects of TCAD to ensure an efficient tool chain covering from atomistic effects to circuit behavior based on flexible simulation models that can handle new materials, device principles and the ensuing large-scale simulations.

This Special Issue of the IEEE Transactions on Electron Devices will feature the most recent developments and the state of the art in the field of TCAD for processing and for device behavior with a focus on new methodologies that improve the tool chain. Papers must be new and present original material that has not been copyrighted, published or accepted for publications in any other archival publications, that is not currently being considered for publications elsewhere, and that will not be submitted elsewhere while under considerations by the Transactions on Electron Devices.

Topics of interest include, but are not limited to:

- Artificial Intelligence applied to TCAD
- TCAD device models for
  - new materials (2D materials, oxides, organic semiconductors, oxide semiconductors, nanowire devices etc.)
  - new device types (magnetic devices, memristors, spintronics, qubits, sensors etc.)
  - physical effects (ferroelectric dielectrics, thermal transport at nanoscale, atomistic simulation etc.)
  - simulation conditions that push the limits of standard TCAD: ballistic transport, THz frequencies, cryogenic conditions, device degradation, electromagnetic and plasma waves in active devices, transient simulations, noise and fluctuations, microscopic

- simulation of large power devices
- Process simulation
  - Atomistic process simulation to generate structures for atomistic device simulations (including both interconnects and transistors)
  - Gate stack modeling including dipole diffusion
  - Stress simulation for nanosheet and forksheet devices and stress simulations including layout effects
  - Topological simulation
  - Equipment simulation
- New methods for the TCAD tool chain
  - Self-consistent integration of simulation models into the hierarchy
  - Device-circuit interaction
  - Multi-physics and multi-scale integration
  - Efficient use of the data produced along the chain
  - Workflow improvements
  - Methods that improve the turn-around-time for TCAD simulations

**Submission instructions:** Manuscripts should be submitted in a double column format using an IEEE style file. Please visit the following link to download the templates: [http://www.ieee.org/publications\\_standards/publications/authors/author\\_templates.html](http://www.ieee.org/publications_standards/publications/authors/author_templates.html)  
In your cover letter, please indicate that your submission is for this special issue.

**Submission deadline: February 28, 2021**

**Publication date: November 2021**

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