Applied MDLx™ Ginestra™ Simulation Software

Solutions and Key Features
Ginestra™ Solutions

Ginestra is an innovative software platform that enables design and optimization of devices from materials based on performance, reliability and variability requirements.

Features:

- Simulate electrical behavior for various material-device structure combinations
- Based on first principles treatment of carrier transport in different materials
- Accurate modeling of electrical properties at nanoscale and macroscale including defects and interfaces
- Transient, pulse and DC electrical characteristics together with long term reliability estimates
Memories and Novel Devices

Ginestra enables Novel Device Design by leveraging material properties

Features:

- Design novel devices or optimize existing technologies with the automatic Ginestra optimization tool
- Simultaneous optimization of multiple Figures of Merit for specific functionalities
- Comprehensive electrical tests covering all aspects of Performance, Variability, and Reliability

Design of novel devices by identifying materials combinations and device geometries for optimum device performance
Designing Resistive RAM Using Ginestra

Features:

- Simulation of a full FORMING-RESET-SET cycle
- **FORMING**: Field-Induced Temperature-Driven positive feedback
  - Field and Temperature-Driven diffusion of atomic species
- **RESET**: Partial oxidation of the Conductive Filament due to Field-Driven diffusion of oxygen ions
- **SET**: Field-Induced breakdown of the oxide barrier
  - Oxygen diffusion recreates the oxygen reservoir
Resistive RAM Simulations

**FORMING:** Field-Induced Temperature-Driven positive feedback
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Identification of material properties affecting device performance
- Oxygen diffusion properties control RESET voltage

From **digital to analog switching:** Link between material, conductive filament properties and device electrical behavior
Material Characterization

Features:

- Automatic extraction of key materials properties from electrical measurements (IV, CV, GV, BTI, TSCIS)
- Full characterization of defect energy and space distribution
- Identification of atomic defect species affecting device electrical characteristics

Fast characterization of material and defects properties from automatic interpretation of multiple electrical measurements
Defect Spectroscopy

Method for extracting defect density depth profiles using a combination of electrical measurements
Electrical Characterization

Ginestra simulates key device characteristics that encompass performance, variability and reliability.

Features:
- Simulation of DC, pulsed and transient electrical characteristics
- Accurate over wide range of voltages, times and temperature

Accurate DC, AC and transient electrical characteristics determined by accounting for the effect of bulk atomic structure, interfaces and defects.
Reliability and Variability

Ginestra allows visibility into long term reliability and performance degradation of devices under operating conditions

Features:

- Multiscale simulation of SILC, BD, BTI, RTN
- Use built-in module for statistical simulations to assess device variability
- Predict device lifetime for multiple different operating conditions and applications

Models link microscopic material properties to electrical characteristics
Ginestra 3D

New FEM-based approach for arbitrary 3D geometries

Features:

- Finite Element and Finite Volume
- Highest accuracy through hexahedral mesh with local refinement capabilities
- Tunneling and quantization effects
- Individual defects considered
- 3D templates: FinFET, 3D CTT NAND, DRAM

Understand how defect-related issues affect performance, variability and reliability of state-of-the-art logic and memory technologies.