



SILVACO

Power Device Solutions

Full TCAD to SPICE Flow

Contents

- Silvaco Solution Enablers
- Silicon Devices
- GaN Specific Capability
- GaN Devices
- SiC Specific Process Capability
- SiC Devices
- Gallium Oxide Devices
- SPICE Model Generation
- Conclusions

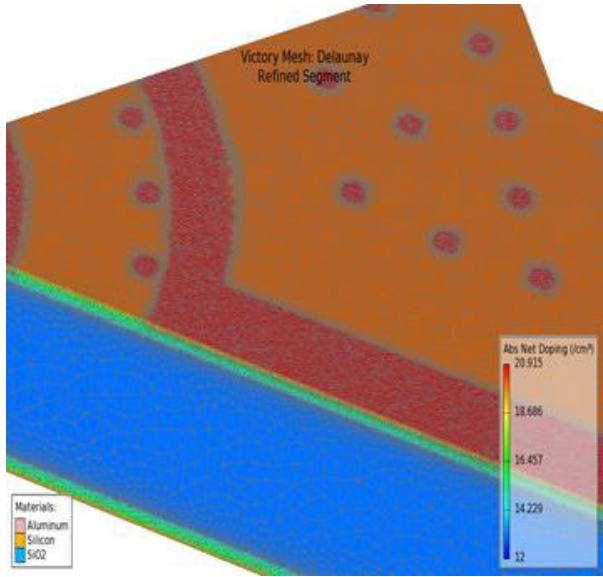
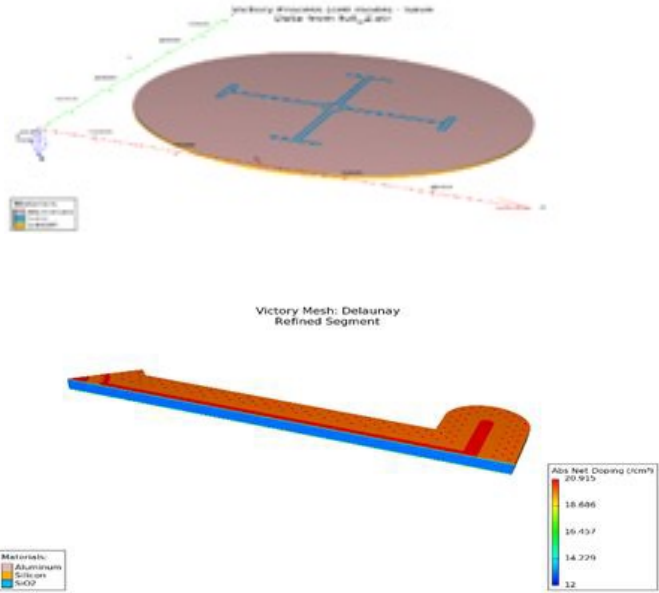
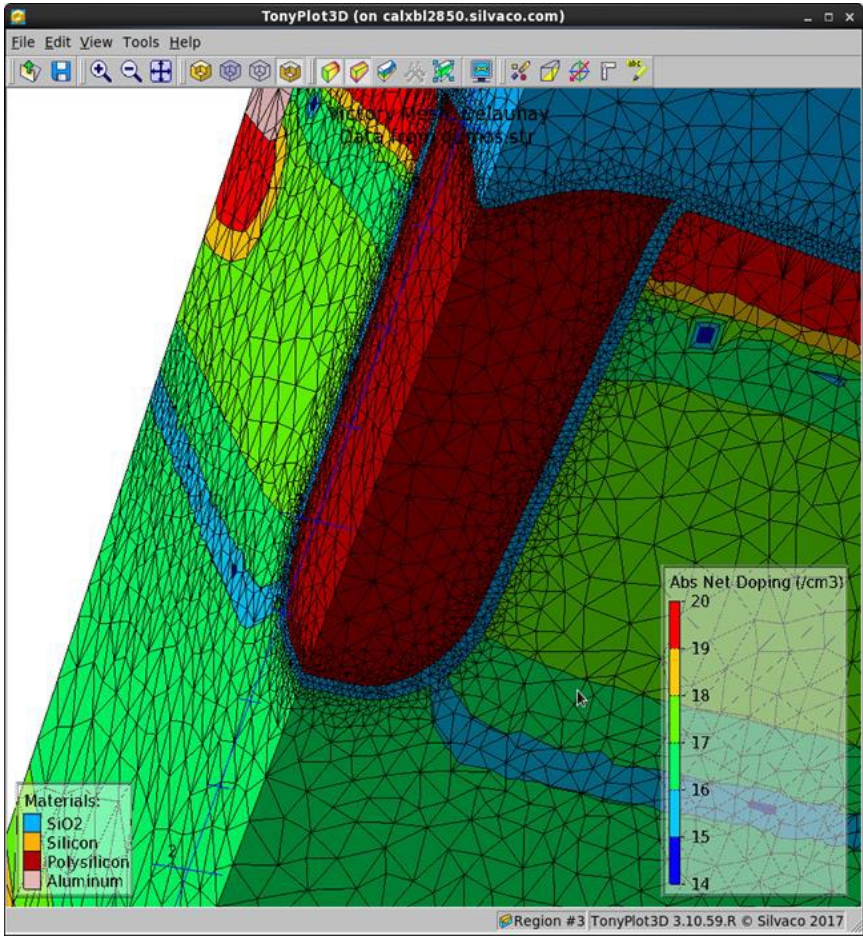
Silvaco Solution Enablers

- Efficient meshing for large devices
- Material specific:
- Direction dependent 3D oxidation
- Implantation channeling
- Dopant activation characteristics
- Stress dependent piezo electric charge generation
- Add additional test components with mixed mode
- SPICE model creation
- Up to 320 bit extended precision



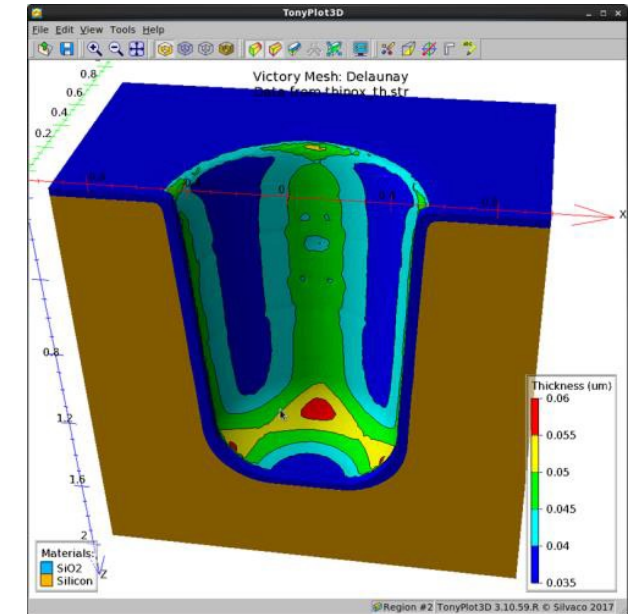
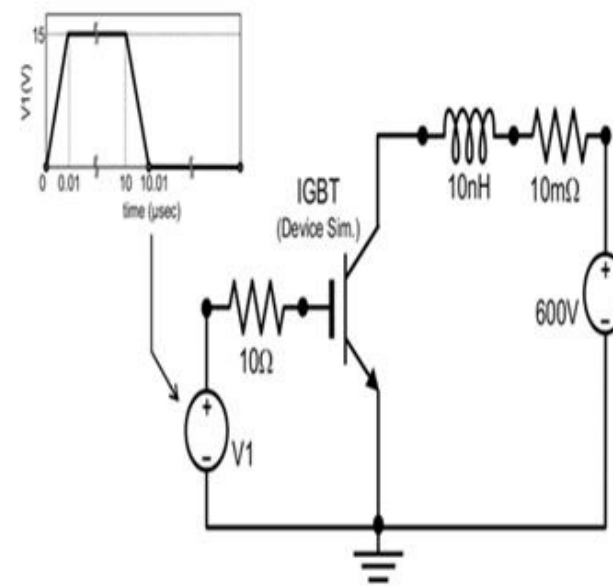
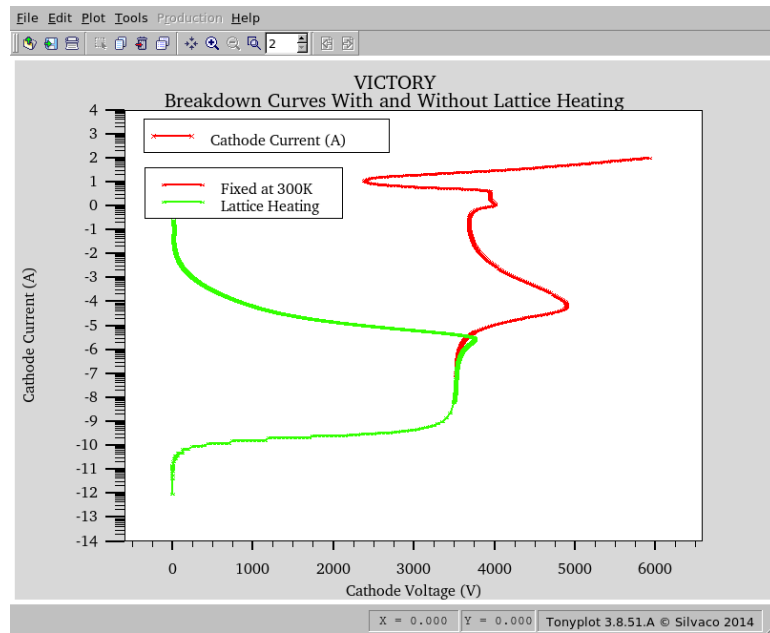
Silicon Devices

- Standard processing, but...
- Devices can be very large
- Requires efficient meshing



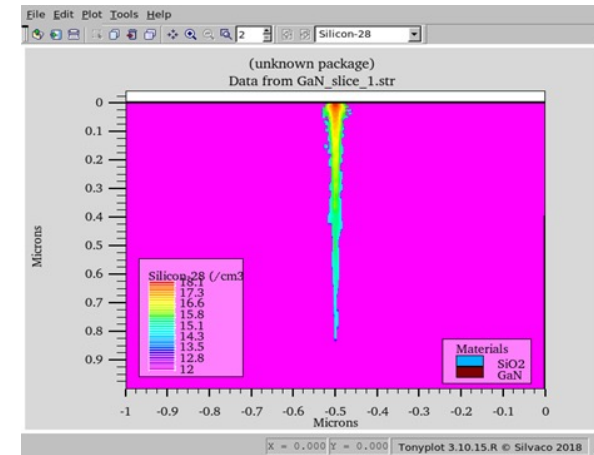
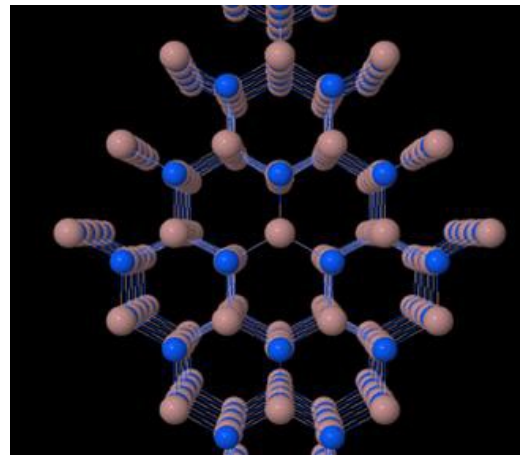
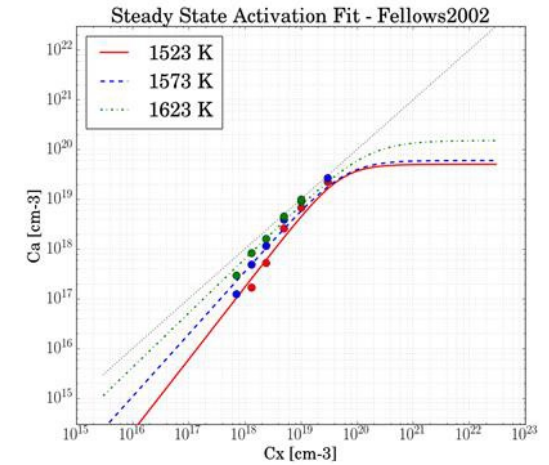
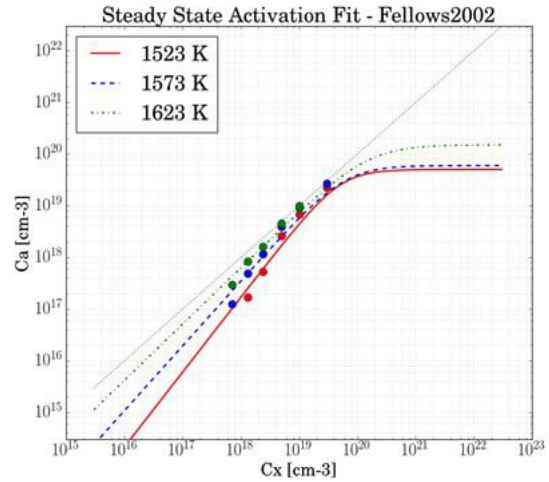
Silicon Devices

- Suite of solvers for difficult simulations
- Mixed Mode operation for standard circuit test loads
- 3D plots rendered by layer thickness



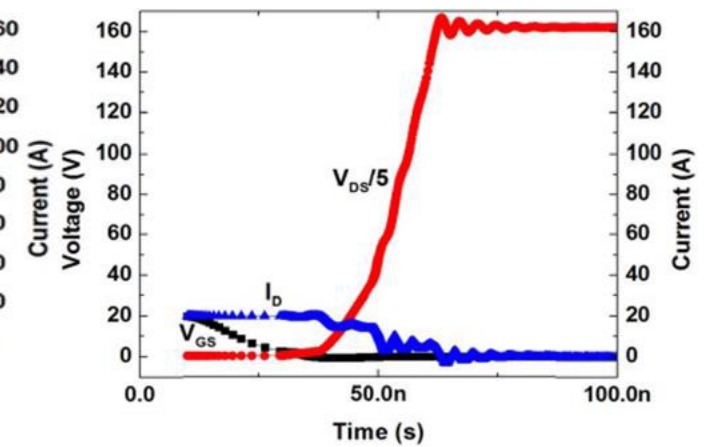
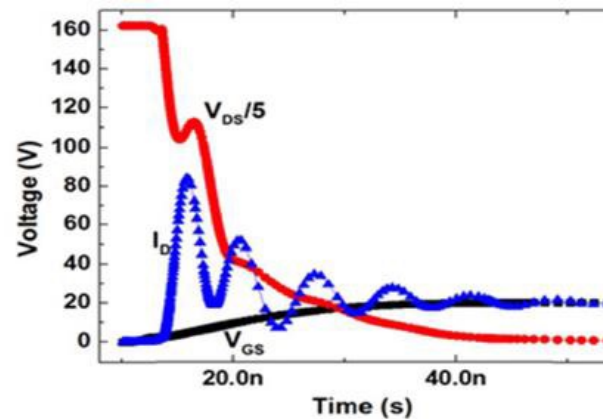
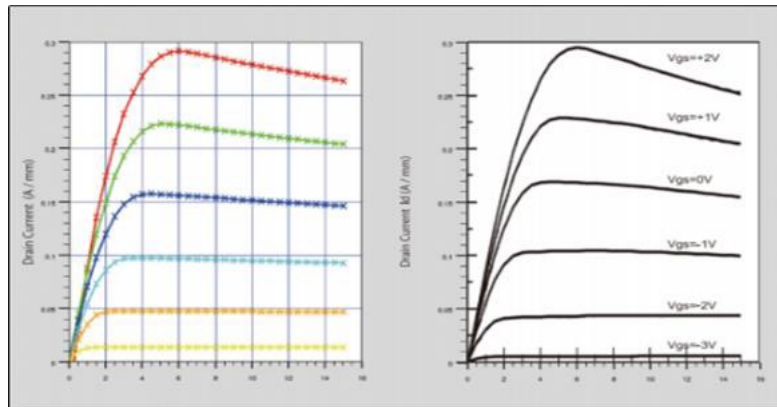
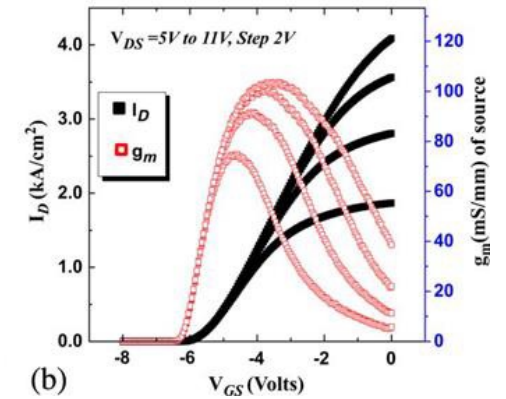
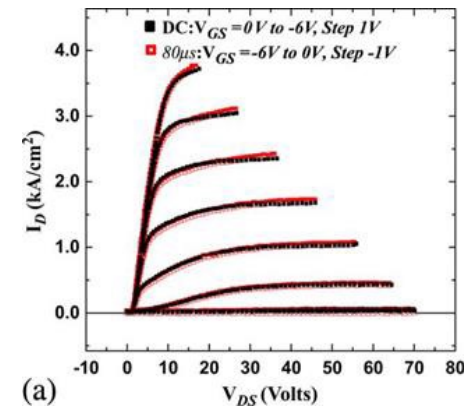
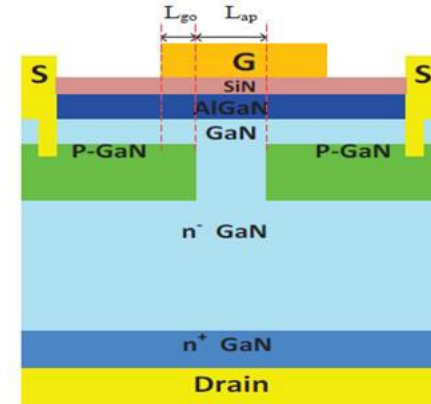
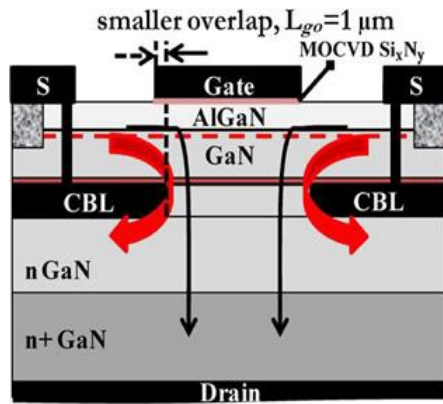
GaN Specific Capability

- Calibrated implant activation and diffusion models (Si Mg)
- Automated piezo electric charge calculations
- External strain generated piezo electric charge



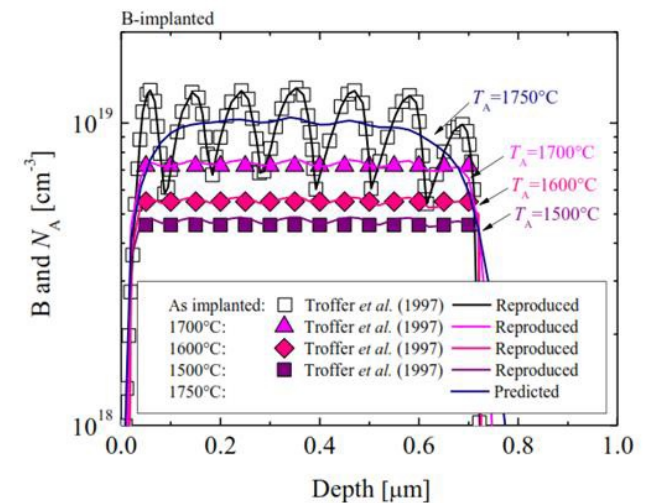
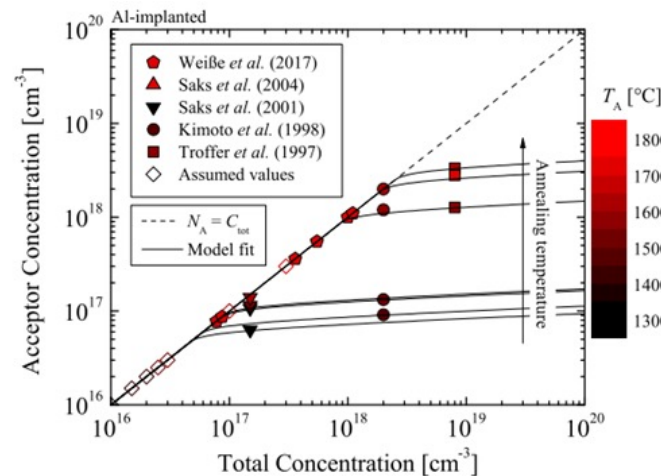
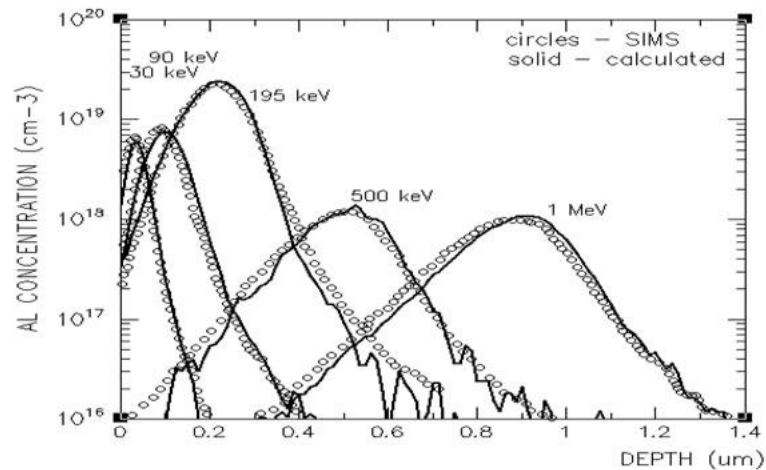
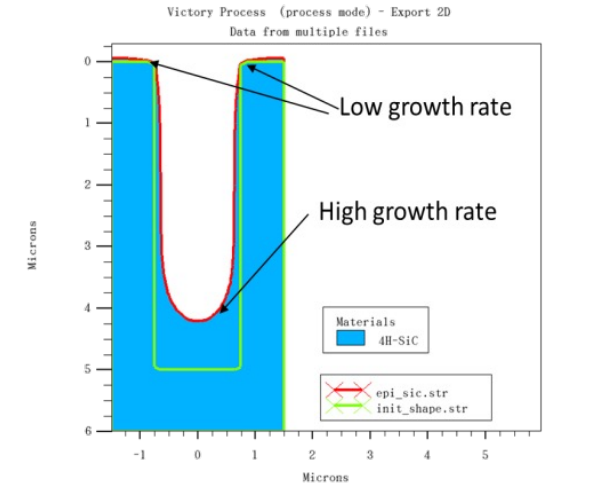
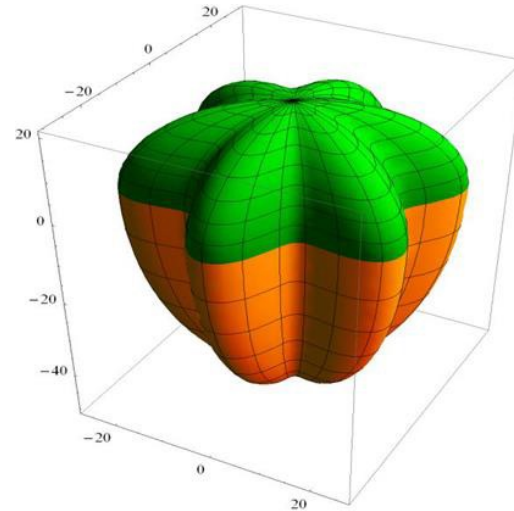
GaN Devices

- Simulations verified by numerous measured results



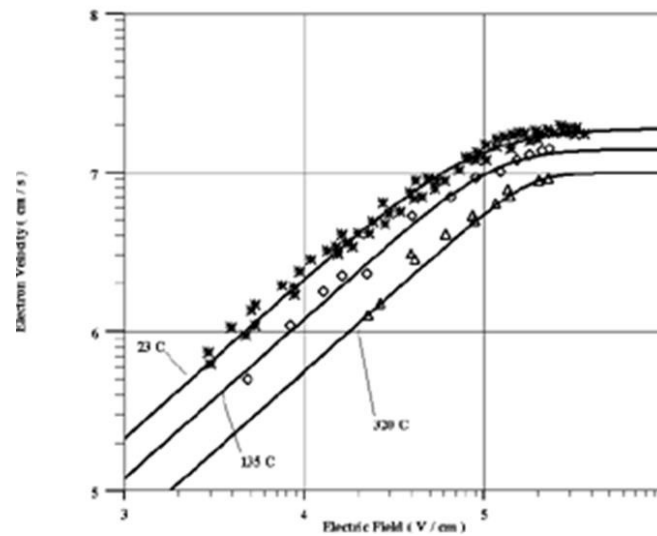
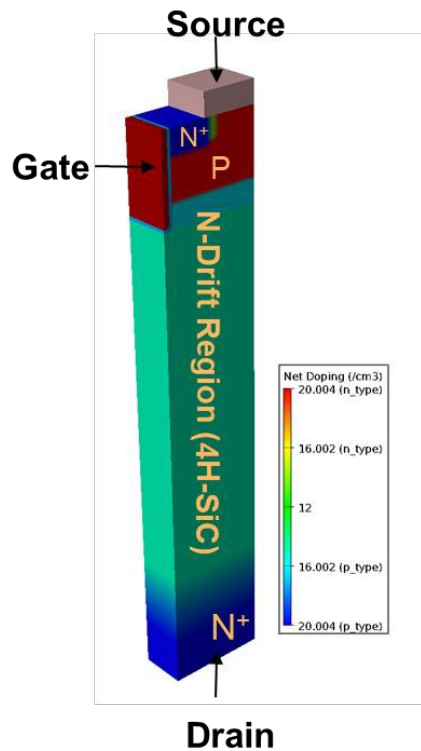
SiC Specific Process Capability

- 3D directional oxidation rates
- Dopant activation rates
- Calibrated Monte Carlo implantation

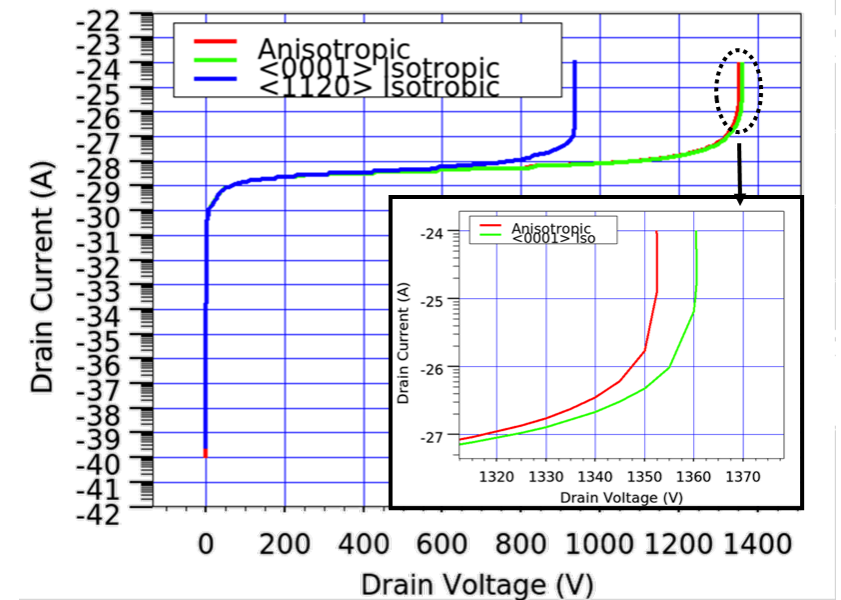


SiC Devices

- Temperature dependent velocity field characteristics
- Anisotropic mobility, impact ionization rates

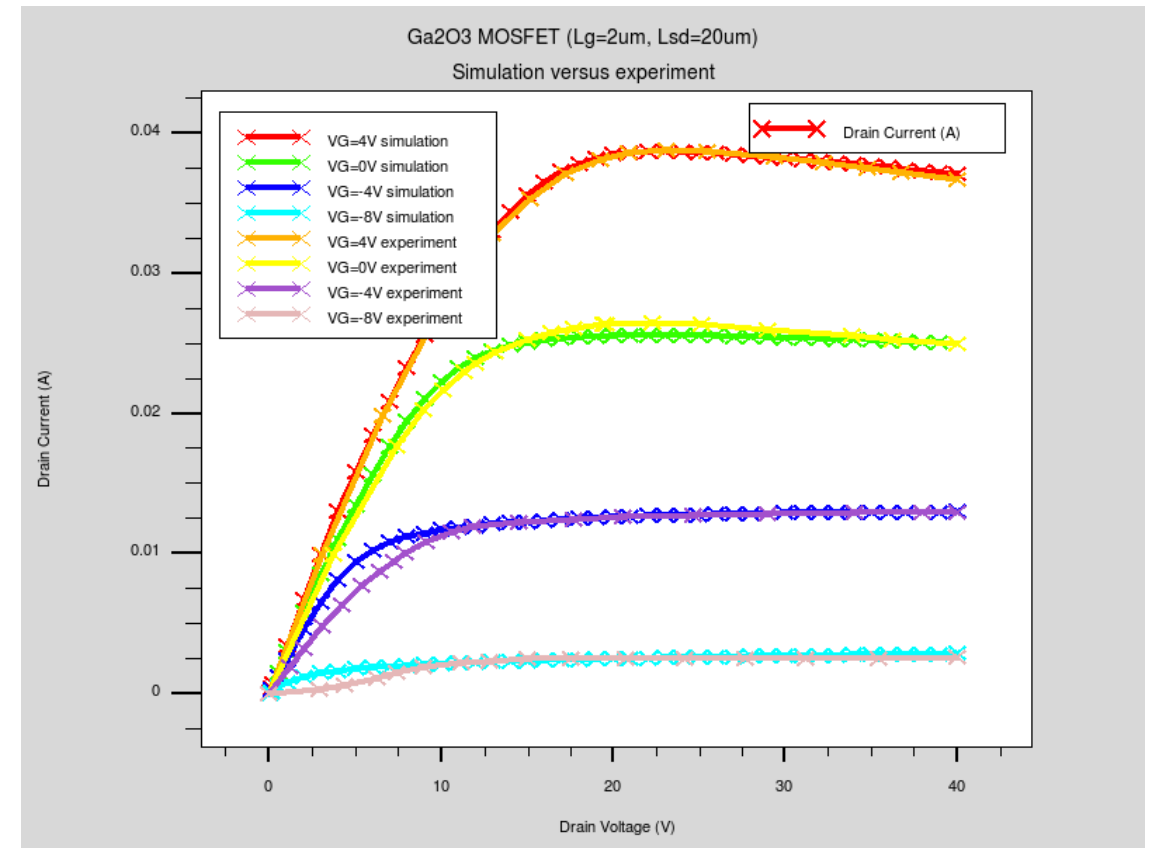
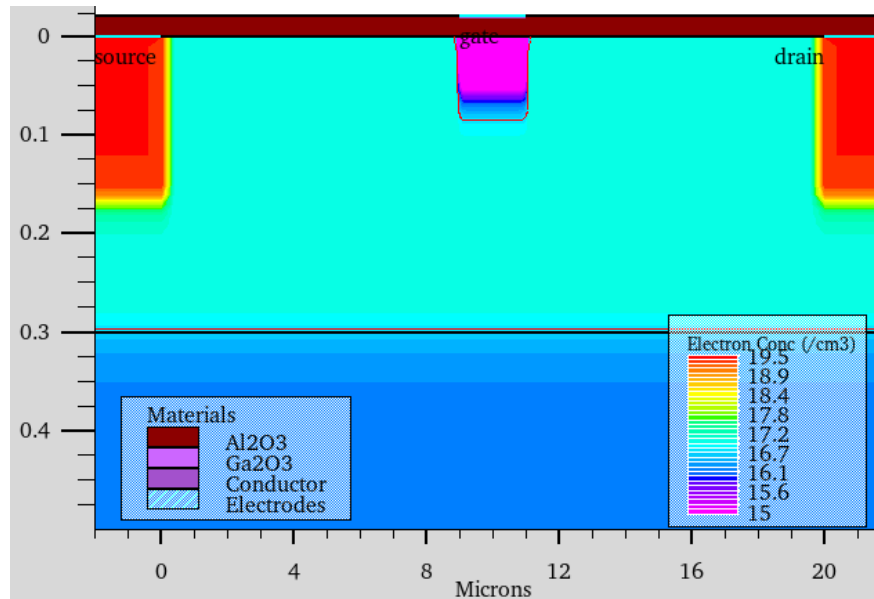


Velocity-Field Characteristics for (0001) 6H SiC for 23 C, 135 C, and 320 C, Simulated (solid lines), Experimental (symbols)



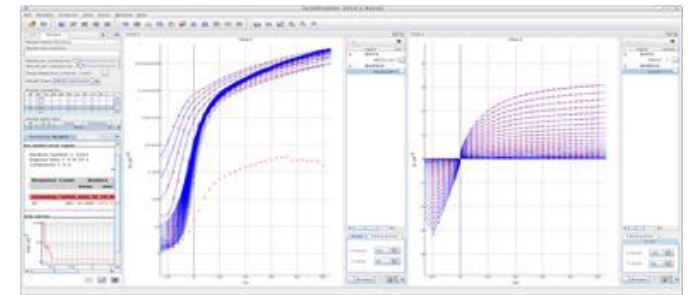
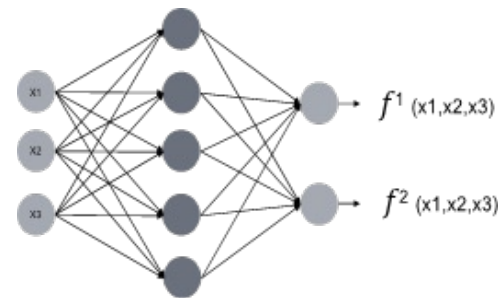
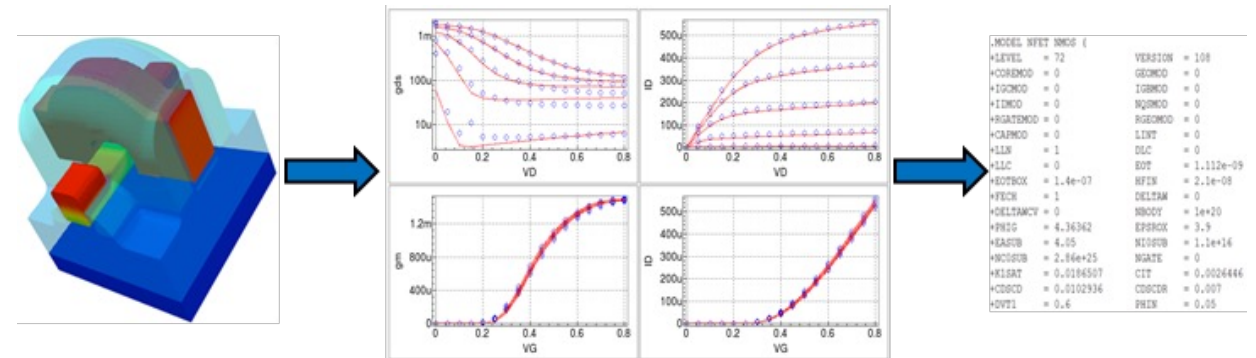
Gallium Oxide Devices

- Large bandgap
- High breakdown field
- Limited to unipolar devices



SPICE Model Generation

- Utmost IV generates SPICE models from physical measurements or TCAD data
- Tech Modeler universal Verilog A model generator
- Physical lab measurements and modeling services



Conclusions

- Many material specific calibrated parameters
- Powerful efficient meshing techniques
- Mixed Mode device simulation with external components
- Simulate self heating, destructive breakdown, transients, small signal, radiation effects etc.
- SPICE model creation from physical measurements or from TCAD generated data