SILVACO INTERNATIONAL

ATLAS

Release Notes

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1:Version 5.14.0.R

1.1: New Features

1.1.1: General Features

- Added the MERCURY module for fast FET simulations.
- Added the capability to create a circular mesh in ATLAS2D.
- Added the materials: OxyNitrid, Al2O3, BSG, BPSG IGZO, HfO2, HfSiO4, and NPB
- Added the parameter ERFC to the DOPING statement. This specifies the use of the complementary error function to calculate the analytical doping profile.
- Added support for general quadrilateral shapes for region boundaries specified on the REGION statement.
- Enabled direct tunneling (e.g., QTUNN and QTUNNSC) and Fowler-Nordheim tunneling (e.g., FNORD and FNHOLES) through insulators, which have been changed to semiconductors using the SEMICONDUCTOR parameter on the MATERIAL statement.
- Added a new carrier and doping concentration dependent model for the Auger rate coefficients suitable for modeling silicon under high and low injection conditions.
- Added or improved C interpreter functions for mobility, heterojunction thermionic emission, band-to-band tunneling, mobility, single-event upset, impact ionization, and phonon drag for thermal power calculation.
- Added floating gate to control gate tunneling for metallic floating gates.
- Added a new implementation of non-local band-to-band tunneling.

1.1.2: OLED/OTFT Features

- Added electrode quenching model to the singlet exciton equations.
- Added photogeneration of excitons.
- Added dipole-dipole energy transfer for singlet exciton equations.

1.1.3: Luminous2D Features

- Implemented finite difference time domain analysis in two dimensions as an alternative to ray-tracing to calculate photogeneration distribution.
- Added optical reflectivity override for electrodes in LUMINOUS2D.
- Added the SOPRA database of complex index of refraction for various materials.

1.1.4: TFT Features

- Implemented steady-state amphoteric defect model for amorphous hydrogenated silicon a-Si:H.
- Implemented a light induced defect generation model for a-Si:H.

1.1.5: Quantum Fetatures

- Added an option to choose direction and dimensionality of 1D and 2D Schrodinger solvers in ATLAS2D and ATLAS3D.
- Added a predictor-corrector scheme to all 1D and 2D Schrodinger-Poisson solvers in ATLAS2D and ATLAS3D.
- Added a fast ("product space") 2D Schrodinger solver to ATLAS2D.
- Added a fast ("product space") 2D Schrodinger solver to ATLAS3D.
- Added a coupled and uncoupled mode-space NEGF solver to ATLAS2D to model ballistic quantum transport.
- Added a coupled and uncoupled mode-space NEGF solver to the cylindrical mesh in ATLAS2D.

- Added a coupled and uncoupled mode-space NEGF solver to ATLAS3D.
- Added an exchange-correlation correction model to all Schrodinger and NEGF solvers in ATLAS2D and ATLAS3D.
- Added an option to specify Schrodinger-Poisson rectangular mesh in ATLAS3D.

1.1.6: Device3D Features

- Added general purpose cylindrical meshing.
- Added generalized cutplane export.

1.1.7: MIXEDMODE Features

- Added arithmetic expressions to MIXEDMODE and MIXEDMODE3D.

1.1.8: LED Features

- Added the capability of outputing multiple spectrum files from the LED statement.
- Enabled the reverse ray trace for LED to accomodate both host and dopant user specified spectra for arbitrary regions inside the LED device.
- Added improved material models and default parameters for a variety of material systems.
- Improved flexibility in gain and radiative recombination modeling.
- Enabled Transfer Matrix Method (TMM) analysis with Ray Tracing (TM) in LED.

1.1.9: OLED/OTFT Features

- Added dopant type defects.

1.1.10: VCSEL Features

- Added Gaussian, Bessel and diffraction-free far-field patterns.

1.1.11: Giga Features

- Added a Phonon Drag term to the thermopower used in GIGA.

2:Version 5.12.0.R

2.1: New Features

2.1.1: General Features

- Added negative differential mobility model to energy balance model.
- Added Schenk trap assisted tunnelling model.
- Enabled small signal analysis with lumped elements in 2D and 3D.
- Introduced strain dependent band gap and mobility in silicon.
- Added electron, hole, total, conduction and displacement currents to the probe capability.
- Added the capability to probe mobilities in 3D.
- Improved energy balance convergence properties.
- Added option to calculate impact ionization based on the gradient of the quasi-Fermi levels.
- Extended heterojunction thermionic emission/thermionic field emission interfaces to 3D.
- Added user definable C interpreter functions for heterojunction thermionic field emission.
- Implemented parallel version of ATLAS 2D.
- Added the Canali velocity saturation model.
- Added the capability to model carrier transport in the presence of magnetic fields in 2D and 3D.
- Implemented the Meinerzhagen-Engl mobility model for hydrodynamic simulations.
- Implemented the van Overstraeten - de Man model for impact ionization.
- Implemented the Okuto-Crowell model for impact ionization.
- Added the Lackner impact ionization model.
- Added the Masetti doping dependent mobility model for silicon.
- Added the capability to probe heat generation terms.
- Implemented the Conwell-Weisskopf carrier-carrier scattering mobility model.
- Added the Brooks-Herring carrier-carrier scattering mobility model.
- Enabled support for 64 bit addressing on LINUX 64 bit machines.
- Added capability to include interface resistance between conductor and semiconductor regions.
- Enabled small-signal AC analysis during transient simulation.
- Added fully anisotropic dielectric permittivity.
- Implemented organic/polymer interface defects.
- Added a C interpreter function for the spatial distribution of traps.
- Added new band parameter models for most III-V cubic material systems that include interpolation including bowing from the binary constituents.
- Added the Schenk Band to Band tunnelling model.
- Implemented Schenk trap assisted tunnelling model.
- Added the Trap assisted Auger recombination model.
- Added the Schenk direct tunnelling modelling.
- Added the Bennett-Wilson band gap narrowing model.
- Added the Scharfetter model of the doping dependence of SRH recombination lifetimes.
- Added the coupled defect level recombination model.
- Added full band-to-band insulator tunnelling model for direct quantum tunnelling currents.
- Implemented lumped element on Schottky boundary conditions.
- Added a non-local band-to-band tunnelling model.

- Implemented the capability to save 2D cut-planes from 3D simulations.
- Implemented hopping charge carrier transport model for disordered organic/polymer semiconductors.
- Implemented hopping mobility model for disordered organic/polymer semiconductors.
- Added a new version of concentration dependent lifetimes.
- Added a model for calculating tunneling current in MONOS/SONOS structures.

2.1.2: Quantum Features

- Implemented 2D Schrodinger solution capability in the general purpose Schrodinger-Poisson solver in ATLAS 2D and 3D.
- Enabled Schrodinger Poission solutions in cylindrical coordinates analogous to 1D Schrodinger solver where the Schrodinger solutions are taken in the radial direction.
- Improved Schrodinger solvers for computation time.
- Added the capability to probe the bound state energies in Quantum.
- Modified Schrodinger-Poisson solver to account for strain effects.

2.1.3: Luminous Features

- Enabled spatial response modelling in LUMINOUS3D.
- Implemented a new lenslet model.
- Implemented Transfer Matrix Method for handling of thin film photodetectors.
- Enabled diffusive reflection on an optical interface in LUMINOUS.

2.1.4: MIXEDMODE Features

- Added subcircuit definitions to MIXEDMODE.
- Added parameter labels to MIXEDMODE.

2.1.5: LED, Laser and VCSEL Features

- Enabled calculation of angular profiles of luminous intensity and CIE color coordinates for LED/OLED.
- Enabled calculation and output of luminous flux, luminous efficiency, and CIE color coordinates for OLED/LED device.
- Introduced implementation of the method of source terms for LED/OLED. Dipole source terms are combined with transfer matrix calculation of light output.
- Added the capability to output seectrum at various angles for LEDs.
- Enabled used defined spectrum in reverse ray tracing for LED and OLED.
- Implemented waveguide small signal AC.
- Introduced (non-uniform) lattice temperature into gain functions and spontaneous recombination rates for optical emitters (LASER, VCSELS and LED).
- Enabled drift of resonance wavelength with change in temperature in VCSEL.

2.1.6: Giga Features

- Incorporated fully anisotropic thermal conductivity.
- Implemented thermodynamically correct Joule heating.
- Added temperature dependence to the saturation velocity of GaAs.
- Added a model for the temperature dependence of Auger recombination coefficients.
- Added temperature dependent SRH lifetime models.
- Added Palankovski's models for thermal conductivity and heat capacity including non-linear temperature and composition dependence.

3:Version 5.8.0.R

3.1: New Features

3.1.1: PISCES Features

- Introduced input deck syntax for compatibility with other Pisces derivative simulators.
- Introduced FLEXLM licensing.
- Improved numerical control over non-linear iteration schemes.
- Introduced two new analytic models for real refractive index for a variety of materials systems.
- Changed the default maximum number of allowable INTERFACE statements from 10 to 100.
- Introduced a mobility model to account for carrier-carrier scattering induced by thickness variations in SOI devices.
- Made improvements to the Darwish modifications to the CVT mobility model.
- Introduced Caughey-Thomas fit for composition dependent mobility in InAlGaN.

3.1.2: BLAZE Features

- Introduced several improved default material models for the InAlGaN system including the effects of bowing and Quaternary composition.
- Introduced the ability to grade strain over a region for calculation of gain and radiative recombination using the k.p models.
- Added a new impact ionization rates model for InP.
- Added simple syntax for choosing between various material default parameter sets for calculation of the k.p models for gain and radiative recombination.
- Added simple syntax for choosing between various material default parameter sets for calculation strain dependent polarization.
- Added material parameter defaults for the InAlGaP system.
- Introduced new default impact ionization parameters for the InAlGaN system.
- Introduced a new default radiative rate constant for GaN, InN and AlN.
- Introduced new default models for temperature dependent thermal conductivity and temperature dependent thermal capacity for GaN, InN, AlN, InAaN and AlGaN.
- Implemented a new universal band-gap narrowing model.
- Introduced a field dependent mobility model for the InAlGaN material system.

3.1.3: LUMINOUS Features

- Added a new aspherical lenslet in LUMINOUS3D.
- Introduced multilayer anti-reflective coatings in LUMINOUS3D.
- Implemented a new light beam definition in LUMINOUS and LUMINOUS3D where you can define an arbitrary bundle of rays to be traced.
- Anti-reflective coatings can now be introduced on any device interface in LUMINOUS3D.
- Improved calculation of reflectivity and transmissivity in LUMINOUS3D to account for the imaginary part of the refractive index during such calculations.

3.1.4: MIXEDMODE Features

- Introduced MIXEDMODEXL. This allows unlimited numbers of circuit nodes, circuit elements and ATLAS physical devices.
- Enabled probe compliance in MIXEDMODE.
- Increased the precision in the MIXEDMODE log files to 10 decimal places.
- Introduce transient pulse and tabular definition into the calculation of time step.

3.1.5: QUANTUM Features

- Added output of wavefunctions in `REGION` based quantum wells.
- Improved control over orthogonality of calculated wavefunctions.
- Introduced a new quantum direct tunneling model for tunneling through thin gate dielectrics.

3.1.6: VCSEL Features

- Added compositional grading to the DBR regions.

3.1.7: LED Features

- Improved LED capabilities to work in cylindrical coordinates.
- Added radiative rate and intensity to the log file.
- Enabled calculation of near field distributions.
- Fixed calculation of output coupling efficiency when 3D nature of light emission is taken into account. Now the results for simple structures agree with analytical estimations (based on escape cone analysis).
- Introduced fast reverse ray-tracing. The new algorithm is based on boundary-to-boundary ray tracing as opposed to element-to-element ray tracing in the old algorithm.
- Output coupling calculations using reverse ray-trace can now account for multilayer anti-reflective coatings.
- Output coupling calculations using reverse ray-trace now account for spectral content of the emitted light.

3.1.8: OTFT Features

- Improved the stability of the Poole-Frenkel mobility model.

3.1.9: DEVICE3D Features

- Introduced a new and improved version of the BICGST iterative linear solver.
- Improved convergence of ATLAS3D with energy balance and impact ionization.
- Improved the consistency of the divergence criteria for energy balance between ATLAS2D and ATLAS3D.

3.1.10: C-Interpreter Functions

- Added a C-interpreter function for electric field dependent work function.

3.1.11: Probe Features

- Added the ability to probe band-gap.