Blaze simulates devices fabricated using advanced materials. It includes a library of binary, ternary and quaternary semiconductors. Blaze has built-in models for graded and abrupt heterojunctions, and simulates binary structures such as MESFETS, HEMT’s and HBT’s.

All measurable DC, AC and transient device characteristics can be simulated. Calculated DC characteristics include threshold voltage, gain, leakage, punchthrough voltage and breakdown behavior. Calculated RF characteristics include cut-off frequency, s-, y-, h- and z-parameters, maximum available gain, maximum stable gain, maximum frequency of oscillation and stability factor. Intrinsic switching times and Fourier analysis of periodic large-signal outputs can also be calculated.

**Complete HEMT and PHEMT Characterization**

The simulation of FETs based on multiple semiconductor materials is possible with Blaze. Models within Blaze include the effects of heterojunction potential steps and compositionally dependent semiconductor material properties.

Solution files produced by Blaze contain internal device variables such as electron concentration. The Schottky barrier creates a depletion layer below the gate. Electrons accumulate in the narrow band-gap materials in the channel.

AC analysis can be performed and S-parameters extracted from the results. S-parameters are displayed for this device for frequencies up to 50 GHz. Simulation well over 100GHz also possible.

A pseudomorphic HEMT with an AlGaAs/InGaAs/GaAs layer structure defined using the graphical structure editor DevEdit. A recessed gate has been included in the design, as well as several buffer layers and delta doped regions.

Band diagram taken through the channel of the HEMT. Discontinuities in potential are seen at the heterojunctions.

An Id/Vds plot is shown for several Vgs values. Extraction of device parameters can be performed on these curves.
Blaze can simulate HBT devices constructed from several semiconductor layers. Blaze self consistently solves complex semiconductor equations to enable detailed optimization of HBT structures.

Using DevEdit a nonplanar HBT structure can be created for simulation by Blaze. An InGaAs/InP HBT structure is illustrated here. DevEdit performs automatic meshing for use in Blaze.

Tools within TonyPlot allow easy manipulation of the output data. Here the band diagram of the HBT is shown through the intrinsic region.

Blaze is used to generate Gummel plots for HBTs. Additional quantities such as device gain can also be displayed.

Impact ionization models allow simulation of breakdown voltages. Here BVCEO of the HBT is shown.
In addition to III-V based devices, Blaze can simulate any compound or elemental semiconductor material.

Examples of results from a Si/SiGe HBT simulation are illustrated on this page.

Blaze simulates materials other than III-V compound materials such as SiGe. This plot shows recombination rate in the base of a SiGe HBT.

Gain (hFE) of the SiGe HBT.

SiGe Technologies Negative Differential Mobility

Blaze simulates negative differential mobility as illustrated by the output oscillations of a GaAs Gunn diode.

Negative Differential Mobility

Fourier Analysis of Large Signal Response

A Fourier analysis routine allows the extraction of a frequency spectrum (above) from any periodic large signal transient simulation output (left). Here the frequency spectrum reveals harmonics in the output of a diode.

Silicon Carbide and Anisotropic Materials

Anisotropic models for mobility, permittivity and impact ionization.

Example of the effects of anisotropic mobility in SiC.
Simulation is used to study the effects of geometry and material properties on all DC, AC, and transient characteristics of GaAs MESFETs. Traps can dominate the DC, switching and RF performance of III-V devices. Blaze allows definition of arbitrary trap levels. This plot shows the effect of EL2 traps on MESFET turn-off.

Electron concentration in an ion implanted MESFET structure generated using Athena.

In gate current analysis and MESFET breakdown, tunneling at Schottky contacts is an important mechanism to include. Thermionic emission may also be included.

**Features**

- DC, AC and time-domain solutions for general nonplanar homo- and heterojunction semiconductor device structures
- Heterojunctions may be abrupt or continuously varying
- Device structure may be specified by the user, or by the output of a process simulator such as Athena
- Boltzmann and Fermi-Dirac statistics with band gap narrowing. Interface to Quantum for quantum statistics
- Drift-diffusion and energy balance transport models with advanced mobility models
- Trap dynamics for DC, transient and AC
- Models for Shockley-Read-Hall, optical, and Auger recombination, impact ionization, band-to-band, and Ohmic and Schottky contacts
- Built-in materials library that contains parameters for more than sixty materials
- C-Interpreter interface allows user-defined, composition dependent, models and material parameters

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