Model Development Using the C-Interpreter

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Introduction

- Generic ATLAS features allowing the user input of physical models and material parameters dependencies
  - The C-Interpreter uses user-defined model files which are interpreted into ATLAS at run-time. Flexibility of model equation definition is maintained but no complication is required
  - Flexible model definition is extremely important as more and more empirically based models are introduced for simulation. These are especially important for non-standard material systems
  - The model files are written by users based on a template

Alternative Approaches

- Traditional way to change physical models in device simulation is through the use of variable parameters in the input language
  - **Advantage**: convenience
  - **Disadvantage:** limited to the models already incorporated and available through the input language
- Alternate approach is to obtain full or partial source codes
  - **Advantage**: more flexibility
  - **Disadvantage**: requires programming skill, libraries, compilers etc., get separate executables for each change in a model, security and support problems

Features

- The list of models available via the C-Interpreter includes all basic physical models: carrier velocities and mobilities, temperature and composition dependent band parameters, position dependent composition, recombination models and their parameters, materials parameters as a function of composition, interface parameters, etc.
- Full list of models and corresponding C-routines with all input and output parameters specified can be found in the template file supplied with ATLAS
- To copy the template file into a file in your current working directory type in the command:

  atlas - T <filename>

Usage Guide

- It is recommended to copy and edit the template to define your own model files
- The model file is specified in ATLAS syntax using the predefined parameter given in the template file and the name of the modified template file which includes the body of the corresponding routine

  Generally: F.<model name>=<model file name>

Example 1

- Concentration dependent mobility for AlGaAs is specified in the modified template file INTERP.LIB. Use the following material statement to activate the model:

```
MATERIAL MATERIAL=AlGaAs F.CONMUN=INTERP.LIB
```

Usage Guide (cont.)

- The interpreted model files can contain any valid C-syntax
- Comparison of models can be done by maintaining multiple model files
- Calculation of respective derivatives may be required as the template file will indicate. It is the users responsibility to correctly calculate these. Bad derivatives will lead to convergence problems
- Models can be constructed to use look-up tables rather than equations
- ‘printf’ statements can be included in the routines to debug the models

Example 2

- The following statement activates the model describing the energy band gap of AlGaAs as a function of Al composition fraction. This is used to describe compositional grading in AlGaAs/GaAs material system:

```
MATERIAL MATEIAL=AlGaAs F.BANDCOMP=EG_XCOMP.LIB
```

Conclusion

- The C-Interpreter allows convenient and flexible definitions of material parameters and models
- ATLAS supports a wide range of C-Interpreter functions