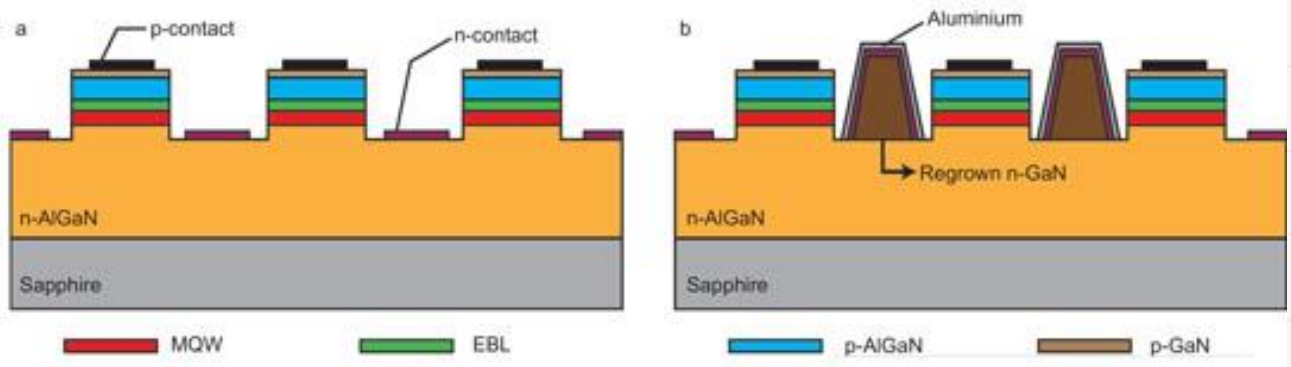
Wrocław University of Science and Technology

Advanced Optoelectronic project



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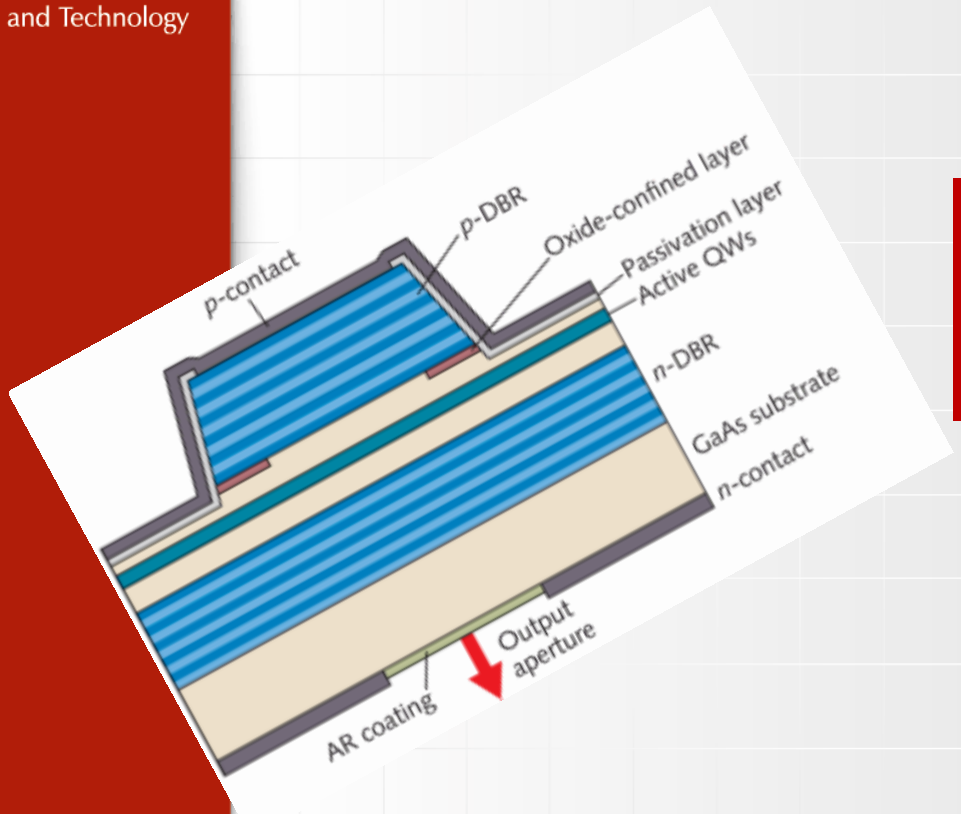

Introduction

Dr inż. Damian Radziewicz

Wrocław 2017

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Introduction

- Information about teacher
- Information about project
- Short information about APSYS

CROSSLIGHT Software Inc.

Simulation software by:

Crosslight Software Inc.

http://crosslight.com/

Information about teacher

PhD Damian Radziewicz

Damian.Radziewicz@pwr.edu.pl

Building C-2: room 306, room 111

Building M-11: room 138 phone 4949 (320 4949)

Consultations:

Monday: $12^{\underline{00}}$ a.m. – $2^{\underline{00}}$ p.m., M-11

Thursday: $11^{\underline{00}}$ a.m. – $1^{\underline{00}}$ p.m., M-11

Information about project

Project	Terms
• APSYS • First easy structure simulation • Second advanced structure simulation • Preparing Reports	• I Report **15th December 2017** • II Report **19th January 2018**

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Short information about APSYS

What you need to start work with **APSYS**?

1. **WinSCP** application to copy files between Windows and UNIX.
2. **Putty** application to use UNIX on your computer with Windows system.
3. Basic knowledge about UNIX system.

UNIX = Linux

APSYS informations 1

APSYS definition

APSYS is a general purpose two-dimensional (2D) finite element analysis and modelling software program for semiconductor devices. It includes many advanced physical models and offers a very flexible modeling and simulation environment for modern semiconductor devices. Advanced features include hot carrier transport, heterojunction models and nonisothermal analysis.

APSYS can be applied to the modeling and analysis of almost all devices except semiconductor lasers (which are simulated by other products **LASTIP** and **PICS3D**).

These include the following devices based on silicon and compound materials.

- 1. Silicon MOSFET's, bipolar transistors and CCD's.
- 2. SiGe HBT's and HBT's of AlGaAs and InGaAsP.
- 3. GaAs MESFET's and Photodectors.
- 4. Devices involving multiple quantum wells.
- 5. Light Emitting Diodes (LED's).

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APSYS informations 2

APSYS solves self-consistently the hydrodynamic equations, the heat transfer equations as well as the conventional drift-diffusion equations. Data generated by **APSYS** include the following:

- 1) Current versus voltage (I-V) characteristics.
- 2) 2D potential, electric field and current distributions.
- 3) 2D distributions of electron and hole concentrations.
- 4) 2D distributions of hot carrier temperatures in the hydrodynamic model.
- 5) 2D distributions of lattice temperature for the heat transfer model.
- 6) Band diagrams under various bias conditions.
- 7) Results of AC small signal analysis for any frequency range.
- 8) Quantum well subband structure with valence mixing model for quantum devices.
- 9) 2D distributions of occupancy and concentration of deep level traps in a semiconductor.
- 10) 2D optical field distribution for photonic devices such as photodetectors.
- 11) Spontaneous emission spectrum as a function of current for LED's.
- 12) All of the above as a function of time (transient model).
- 13) All of the above at different environment temperatures.

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APSYS informations 3

- **.geo** - The main input file that describe the full details of the device geometry and the initial mesh allocation.
- **.sol** - The main input file that defines the material properties and controls the bias and other conditions of main equation solver.
- **.layer** - An important auxiliary input file that uses the layer structure description to generate the .geo, .doping, .mater and .mplt files,
- **.doping** which contains doping information that is to be included in the .sol file.
- **.mater** which contains material information that is to be included in the .sol file.
- **.mplt** can be used to plot the mesh generated from .geo file.
- **.gain** file is another important auxiliary input file that can be used to preview the optical gain spectrum, spontaneous emission rate spectrum, quantum well subbands, and other critical physical properties. This may be used by the user to do some preliminary estimate before the full simulation is performed.
- **.out** files may appear as .out 01, .out 02, etc.. These are numerical output data from the main equation solver. They can be used by the .plt program to be plotted. These output files are not meant to be understood by the user.
- **.std** files may appear as .std 01, .std 02, etc.. These are another form of numerical output data from the main equation solver. They can be used by the CrosslightView program to be displayed in 3D color graphics. These output files can be understood by the user should there were such a need.
- **.plt** file is used to plot the data in .out output files. APSYS calls the public domain software GNUPLOT to display the graphics in various computer platforms and printers.

End of Introduction