PICS 3D – Evaluation (by Sudharsanan S – started on October 14th,2010)

Day 1 – Notes from the manual

PICS3D uses finite element analysis (FEM) to study various Photonic Integrated Circuit (PIC) components.
It uses k.p theory => we can model strained QWs. We can model ternary/quaternary compounds including nitrides.

Applications of the software:

1. Fabry-Perot (FP) lasers.
2. Distributed Feedback (DFB) lasers.
3. Distributed Bragg Reflector (DBR) lasers.
4. Semiconductor Optical Amplifiers (SOA).
5. Waveguide photodetectors.
6. Vertical Cavity Surface Emitting Lasers (VCSELs).
7. External cavity lasers.
8. Fiber grating lasers.
9. Electrode absorption modulators (EAM).
10. Multi-section/Multi-electrode DFB or DBR lasers.
11. Multi-section photonic integrated circuit combining more than one of the above devices.

Capabilities:

1) Light versus current (L-I) characteristics.
2) 3D potential, electric field and current distributions.
3) 3D distributions of electron and hole concentrations.
4) Band diagrams under various bias conditions.
5) Quantum well sub-band structure with valence mixing model.
6) 3D distributions of occupancy and concentration of deep level traps in a semiconductor.
7) 3D optical field distribution.
8) 3D local optical gain distribution.
9) Full multiple mode emission spectra at different power levels.
10) Lasing wavelength, output power and longitudinal photon density distribution as a function of bias current.
11) Characteristics of DFB lasers with spatial and spectral hole burning effects.
12) Full multi-mode simulation of DFB lasers.
13) Relative Intensity Noise (RIN), Frequency Noise (FM) and spectral line-width under different bias conditions.
14) Static tuning and dynamic modulation characteristics of single- and multi-electrode DFB or DBR lasers.
15) Second harmonic distortion in a laser system under direct current modulation.

The 3 basic file types:
*.layer – input device structure/generate mesh, (generates *.geo, *.doping and *.mater files)
*.sol – solve the equations (material properties, control bias)
*.plt – plot the results using GNUPLOT.

Others
*.geo – device geometry and initial mesh location.
*.doping – doping info (to be included in *.sol file)
*.mater – material info (to be included in *.sol file)
*.mplt – plot mesh generated from *.geo file.
*.gain – use to preview optical gain spectrum, spontaneous emission spectrum, quantum well sub-bands.
*.out_00xx – numerical output data (used by *.plt file to plot)
*.std_00xx – numerical output data (used by Crosslight view program to plot 3D figures)