

Project Title: Design of high performance THz-QCL and DUV-LED

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Currently, one of the most important issue toward high efficiency deep ultraviolet light-emitting diode (DUV-LED) is how to obtain high light extraction efficiency (LEE). In the case of GaN-based quantum cascade laser (QCL), sophisticated design of well/barrier pairs is firstly required to obtain enough gain. Both researches can be accelerated by utilizing high performance supercomputer.

Therefore, we had tried to utilize massively parallel computer (MPC) to use the simulation software such as MIT's MEEP and Nextnano.QCL to conduct our researches. However, operating system of MPC did not support for both software.

Therefore, I have been developing finite-difference time-domain (FDTD) and non-equilibrium Green's function (NEGF) software by myself as a side work (I enjoy to develop simulators as one of my hobbies).

In the case of FDTD software, I almost finished the development and only remained job is to compile it in MPC. I divided this software as two parts. First part was developed to design three-dimensional structures and to make recipe files for FDTD calculation based on the 3D CAD functions and windows system. Second part is related to the core calculation and it was developed with pure C++ language supporting openMP function to perform parallel computation with MPC. This FDTD software was optimized to simulate any kinds of 2D unit cell with 3D structure, and dispersive material with skewed lattice by adopting constant k method. Figure 1 shows the developed first part of the FDTD software to extract recipe files. Figure 2 shows a simple result calculated by the second part of the software. We will perform FDTD simulation to find optimized DUV-LED structures to maximize LEE by utilizing this software and MPC from next month.

Many valuable researches will be possible soon. Since we have dense schedule to conduct LED and QCL researches, I cannot currently sure when NEGF simulator will be developed for MPC.

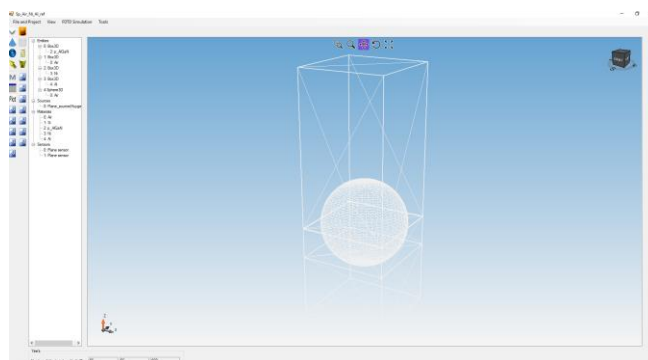


Figure 1. First part based on windows system to create recipe files for FDTD calculation

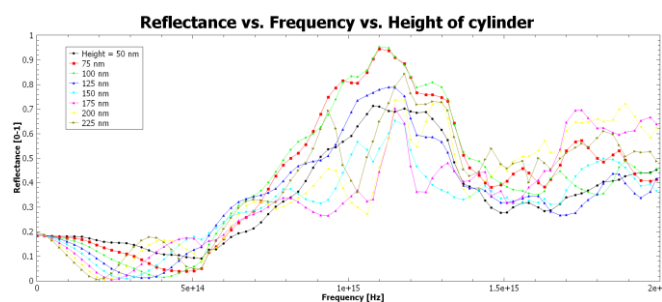


Figure 2. An example of the calculated result by utilizing developed FDTD software

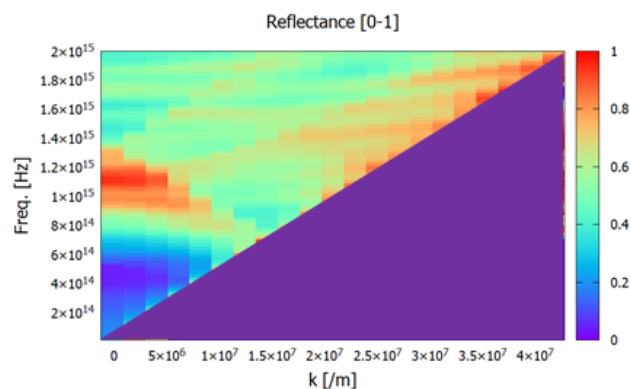


Figure 3. An example of extracted results by constant k method