

Crosslight:

20 years and counting

Founded on the promise of delivering a superior tool for modelling laser diodes, Crosslight has blossomed into a provider of a range of software for understanding III-V technologies

1995 WILL GO DOWN IN HISTORY as a year when entrepreneurs made lasting contributions. For those in the aviation industry, it will be remembered for the launch of budget airline Easyjet by Greek Cypriot businessman Sir Stelios Haji-Ioannou; and for those working in pharmaceuticals, it was the year Indian law and commerce graduate Sanjiv Goyal founded NecLife, a maker of generic medical products for the US and Europe that is now employing more than 2000 staff.

In the compound semiconductor industry, success stories from this year might not be as big – but they have, without doubt, made a lasting impression. 1995 was the year that Marie Meyer produced the inaugural issue of *Compound Semiconductor* magazine; and it was the year Simon Li founded Crosslight, a pioneer of laser diode modelling software.

Since then, this Canadian firm has made many important contributions to our industry: It has trailblazed the modelling of lasers with quantum wells rather than double heterostructures; it has produced software for simulating VCSELs and integrated circuits incorporating III-Vs; and it has been a fervent supporter of NUSOD, by far the most important conference for the simulation and modelling of optoelectronic devices.

Getting going

Li began his life in China, studying Electrical Engineering at Zhongshan University and graduating at the age of 20. “At that time,” says Li, “China was under Mr Deng Xiaoping, a man who opened up trade to the outside world.”

What that meant for the most talented graduates of that time, including Li, is that they no longer had to study for higher degrees in China, but could

head overseas. Numbers were limited for physicists, with selection based on the marks obtained in an exam. This was organised by Columbia University academic Tusng-Dao Lee, China’s first winner of the Nobel Prize for Physics, for his work on the violation of the parity law in the weak interaction.

Li passed the exam, winning one of about 100 places for physics students. So, in 1982, he left his homeland for Vancouver, hoping to satisfy his interest in high-energy physics.

However, Li didn’t get the chance to study the interactions of fundamental particles. “The government of Canada said that students should mostly work on experimental physics, because that is what China needed at the time,” explains Li. He specialised sputtering, but didn’t get very far as an experimentalist. “If a piece of equipment broke down and I



Crosslight has kept track of its sales, with products being bought from companies all over the world.

had to wait, I'd start to work on an optics problem." This suited him, as he had more success writing lines of Fortran than working in the lab.

One downside of this shifting of the emphasis of his research is that it spawned a thesis lacking a clear, coherent thread. "By the time I got the PhD written up, the examiners were confused. They didn't really know if the thesis was about sputtering, experimental physics, or optical problems." Fortunately, he convinced them that the various elements of his work were intertwined, allowing him to leave the university in 1988 with a Masters Degree and a PhD.

Li's sputtering expertise nearly landed him a job with the data storage firm Seagate Magnetics. However, he could not get a visa, so instead of moving from Vancouver to the US, he headed east to Ottawa, taking up a position at the National Research Council of Canada (NRC).

"I did a little bit of sputtering, but my group found out that I did very well with coding and modelling," says Li. His boss

understood Li's strengths and put them to good use. So great was the research that followed that after one year of Li's two-year temporary post of research associate, he secured a permanent staff position.

Starting up

Although this gave Li a comfortable life as a scientist, he did not have high hopes for the future. He wanted to rise through the ranks, but knew that there were poor prospects for foreign-born researchers. Recently, one of his peers, Chander Gover, had been denied research funds, summer student assistance, and approval for conference participation (Gover took the NRC to a tribunal, winning the case in 1992, with the employer fined for discriminating against him on the grounds of race, colour and national origin).

By 1993, Li started to mull over the idea of starting his own company. "I didn't know anything about getting seed funding, getting licensing, or anything like that ... [and] I didn't know if the idea would work." But he did start to plan for a possible launch: he wrote to authors of academic papers, asking if they

would be interested in using his laser diode software; he started to squirrel away his earnings to fund a venture, amassing \$20,000; and encouragingly, he managed to make his first sale, an order worth \$3000 from the University of Tampere, Finland.

Li's success would hinge on winning more sales of his software for quantum well laser diodes. To succeed, he would need to set himself apart from his rivals – and he believed he could do this: "I was the first to put the modelling of the optical gain in the quantum well into a drift-diffusion solver." The two biggest challenges that he had to overcome to construct his code were: modelling the transport of carriers across a heterostructure; and providing data to describe the characteristics of compound semiconductors, which vary according to alloy composition. In comparison, the models made by Li's peers were analytical, and failed to include a drift-diffusion component.

Researchers often write code that is used just by them, so they don't need to make it accessible to others. But Li is of a

different mindset – even in his days as an experimentalist, he took an approach that his colleagues could follow. “I started to make some forms that people in the lab can use,” recalls Li. “You can think of it as a simple user interface.”

It is not surprising, therefore, that the laser diode program he designed was very user-friendly. And to help the researchers make best use of it, the software includes a question and answer feature.

By 1995, Li had built up enough confidence in the venture to take the plunge. But to do so, he needed a license for the software. He overcame this obstacle, striking a deal with the NRC, and took leave without pay. Initially, he rented a 400 square feet of office space in a local business park.

At that time Li often wondered whether he could make enough money to survive. So, to give him the best possible odds, he responded to customers as fast as he could, regularly putting in 15-hour

days. It did not take long to reap the rewards, and within two months Li had hired James Wu, an electrical engineer, to respond to swelling interest in the software.

Li’s program was designed to run on Unix, because that was the type of machine owned by the NRC. But this limited potential sales, because many researchers worked on Sun stations. To right this wrong, Li hunted through advertisements, trying to pick up one of these machines for as little as possible. “Once I had that, I had to buy the Fortran compiler. They are not really universally available, so I had to look around.”

Linux then came out, forcing Crosslight to adapt its laser diode software once again, while trying to support customers as much as it could. “I recall that some people didn’t want to install [Linux] themselves,” says Li, “so I bought a PC and installed it on it. Somehow, when it passed US customs, they took it all apart. The customer was very mad. He returned

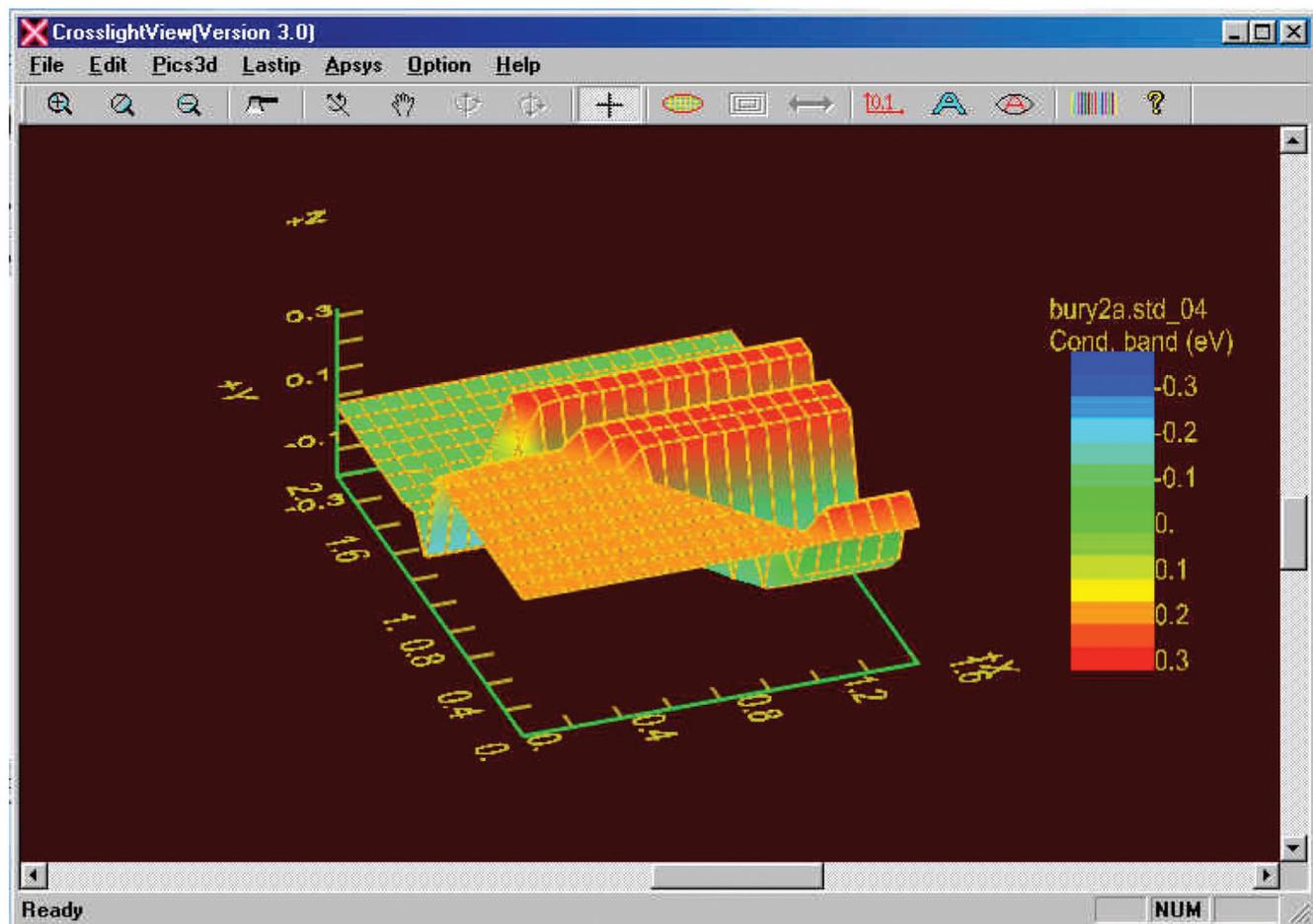
the whole thing to Canada.”

With a price tag at the time of \$20,000 to \$25,000, it was tough to persuade purchasing managers to invest in the software. So, to convince companies of the benefits of this modelling tool, Crosslight offered customers a two-month free trial. After this evaluation period, Li would leave the sales manager, Richard Rembaran, to tie-up the deal. His lack of a science background meant that he had very little knowledge of laser diodes – but his friendliness and ability to get on well with scientists and engineers meant that during his time at Crosslight – 1996 to 2001 – he had great success in this role.

Expanding the business

Rarely can a company survive and succeed on a single product. So Li directed efforts at expanding the product line, extending the capabilities of the existing software from handling two dimensions to three.

“At the time I had the opportunity of working on VCSELs,” explains Li. “You



In the early years of Crosslight, a great deal of effort was devoted to improving the graphical user interface of the simulation software. By 1999, versions that could run on 'Windows' were available.

can think of the VCSEL as a three-dimensional problem, because of the coupling of the longitudinal mode with the electrical current.”

Back then sales of Crosslight software, particular in the US, were held back by a lack of a graphical user interface. To address this, Li hired some software engineers. He couldn't afford to recruit in Canada, so he started an operation in China, taking on a handful of employees from 1997. “Very few people knew how to make a graphical user interface program, but it didn't matter – I trained them.”

Another milestone for Crosslight was the moving of its headquarters from Ottawa to Vancouver in 2001. Li preferred the climate on the west coast, and a location that is better suited for travelling to Japan and China, countries that account for a high proportion of Crosslight's sales.

At that time the software house had grown to 25 employees, sold its products to big-name firms such as Lucent Technologies, Nortel Networks, JDSU and Samsung; and its revenue, growing at around 30 percent per year, had hit \$4 million. Since then, Crosslight has had further success, including establishing an office in Japan in 2002. This led to savings, with the elimination of agency commission fees.

One triumph from this era was the role Crosslight played in the launch of the NUSOD conference. Li had the idea for launching a modelling of optical devices conference that would have at its heart the delivery of tutorials for Crosslight software.

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This led Li to cofound NUSOD with Joachim Piprek, who was also keen to teach others how to make best use of the software. “In his own words, Lastip and Pics3D were the only programs that allowed you to do anything,” says Li.

This freedom resulted from a material library that sits outside the program, allowing modellers to change material characteristics, such as bandgap and effective mass. Another highlight in the history of Crosslight came in 2005, when the company licensed process simulation software developed at the Integrated Circuits Laboratory of Stanford University.

“It was a difficult start, but now we've got it rolling out after ten years,” says Li, explaining that the biggest challenges were to extend the simulator from two-dimensions to three, and to enable

the software to cater for compound semiconductors.

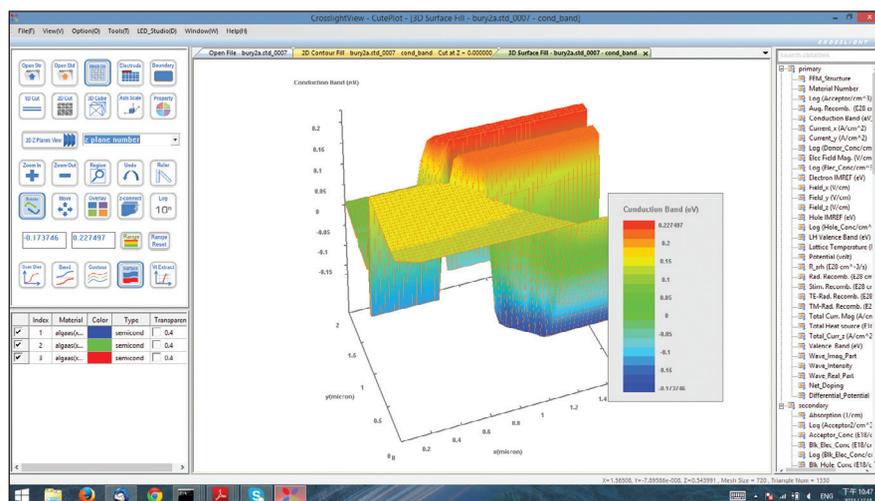
It is virtually impossible for any long-running company to have success in all its ventures. With Crosslight, it is the simulation software for MOCVD reactors that has failed to recoup its investment. Li hoped that epitaxial process engineers would buy this modelling tool, but the only interest came from the makers of MOCVD reactors.

Given the recent explosion in sales and shipments of LEDs, one would expect that Crosslight's software for modelling this particular device could deliver tremendous success. However, that's not the case: Technology computer-aided design software developed by the company includes terms related to diffusion, implying that it cannot account for the controversial, energy-sapping malady known as droop. “If you don't understand it, you can't model it. And if you can't model it, people are not going to buy your programs.”

To grow sales, Li is now directing his company in the development of software for modelling power electronic devices, such as GaN HEMTs. “The simulation can predict more, because the physics is better known, compared to droop.”

Such a move will be a significant step for Crosslight, which, for the last 20 years, has focused on modelling optical products.

“Maybe the name Crosslight is no longer appropriate,” muses Li, “so maybe a name change, or call it Crosslight Compounds.”



Today's software has an interface that is more sophisticated than that from 1999, but it has elements that can be traced back to its forerunner.