opinion collaboration

A new way of working

When a university installs its reactor in a commercial foundry, there are benefits for students, research groups and the chipmaker

BY RICHARD HOGG FROM THE UNIVERSITY OF GLASGOW

WHEN BUSINESS IS BOOMING, manufacturers of compound semiconductor devices find it a challenge to recruit PhD graduates with experience in MOCVD growth. Expertise on this front is highly valued because the growth of high-quality epilayers using this technique is a key process in the production of LEDs, lasers, solar cells and transistors.

However, it is unlikely that these PhD graduates will hit the ground running when they start work in a III-V foundry. Their skills have been honed on small tools designed for growing material for research purposes, in labs run in a manner that are research focused, and so not aligned with best practice for high-volume production. These new recruits will only be at their most productive after being given a chance to acquire the skills to run a high-throughput MOCVD reactor, housed in a cleanroom with a strict set of operating guidelines in terms of quality, yield, and cost.

But it doesn't have to take this long to get up to speed. The solution is to adopt another way of working: site the university's MOCVD tool in an independent, volume-producer of III-V compound semiconductors. That's the approach we are pioneering at the University of Glasgow, with our reactor housed at CST Global's manufacturing facility in Blantyre, on the outskirts of Glasgow.

This new facility is jointly managed by ourselves and CST. This approach to operating an MOCVD tool is not just of great benefit to the PhD students. It's also a winner for the research group, the chipmaker and the local economy.

Our students benefit from working in a commercial setting, with an MOCVD tool operating in a cleanroom complying with ISO 9001:2015 quality, the highest environmental and safety standards, housed besides foundry services. In this environment, our PhD students are rubbing shoulders with experienced engineers on a day-to-day basis. They therefore pick up informed, industrial knowledge, benefiting their development and employability. This unique environment targets the production of work with both commercial value and academic excellence. In turn, this allows us to to recruit high-calibre PhD students, being attractive to those who prefer to work in a commercial environment whilst studying, as it can make them more employable than those who dedicate their time to more fundamental work.

Another great advantage of our new approach is that the novel semiconductor materials and devices developed during our electronics and photonics research projects can be taken seamlessly from the laboratory to commercial, volume production. That's obviously not the case when similar developments occur in universities with more traditional ways of working. In those environments, efforts to commercialise technology often require a senior academic to launch a start-up. That takes a lot of time and effort – but they are not the only drawbacks.

A far bigger issue is the clear conflict of interest between the commercial and academic worlds. In a commercial setting, a company must 'feed' a reactor with R&D and manufacturing work to ensure profitability and achieve a return on investment. Success requires an overhead of strong sales, administration, production and marketing infrastructures, not to mention a customer base to sell to. And the more repetitive the work the better, as margins rise when a tool is optimised for volume production of familiar, repeatable products. This is the domain of efficient business.

By contrast, a university, which holds charitable status, cannot operate effectively in a commercial environment. A university may undertake research projects for commercial entities, but these can be less inclined to further knowledge and understanding; instead they major on the development of

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manufacturing processes and rapid pay-back. A commercial focus therefore often conflicts with the academic aims of the university, where the measure of excellence is research with a high global impact. It is this metric that drives the ratings of our schools; the recruitment of our students; and the level of funding from research organisations and investment from the university. The majority of academics are driven by creativity, and judge their success by various factors, such as the number of citations of their high-quality research papers. Business accolades and efficient production often mean little to them, making their very involvement in managing a spin-off business a possible distraction.

Further benefits of housing a university-owned MOCVD reactor in a commercial setting relate to health and safety and the cost of ownership. Running an MOCVD reactor requires the use of potentially toxic, explosive chemicals. They can be costly to source, have long lead times, and are a security issue. And their use requires infrastructure to ensure safe handling of gases and their abatement. When the MOCVD reactor is sited in a commercial setting, these issues are far easier to address. That's partly because it is far more likely that there are staff with experience of handling environmental protection procedures and legislation. What's more, a university campus is, more often than not, a poor choice to house such a reactor. In our case, The University of Glasgow is surrounded by suburban regions of Glasgow and traversed by several thousand people a day. Additionally, many of our buildings are accessed very easily by our students and visitors. An industrial setting is clearly a far better option!

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In addition, CST Global uses the MOCVD reactor for its research projects, including university collaborations, and has an agreed percentage of the reactor's capacity reserved for its own work. This allows their other growth tools to concentrate on volume production. The CST custom foundry setting, where many separate confidential projects are executed on a daily basis has been beneficial in teaching me new working methods. These allow the MOCVD tool to be included in both highly collaborative working with CST, but also the development of devices and processes with trade secrets being developed and maintained with other collaborators.

Benefits of this way of working even extend beyond those for PhD students, universities and chipmakers: it is good for the nation. In Scotland, by leveraging our academic and commercial infrastructures, we are creating jobs and contributing to the UK economy. This should help us to attract more great people to come to Scotland, furthering our already strong photonics and electronics industries.

Professor Richard Hogg

Professor Hogg heads a group that is researching device physics and engineering, epitaxial processes and fabrication technologies. These efforts are helping to develop diverse applications for semiconductor devices.

Hogg studied physics at The University of Nottingham, before completing a PhD at The University of Sheffield in Semiconductors. He has over 22 years of post-doctoral experience in industrial and university research, including at NTT Basic Research Laboratories (Japan) and in Professor Arakawa's Laboratory at the University of Tokyo as an EU-Japan Fellow. He held a research position at Toshiba, Cambridge, and had a key foundry management role at Agilent Technologies, Ipswich, which was, at the time, the highest volume III-V facility in Europe. He has been Professor at the University of Sheffield, where he worked from 2003 to 2015 and is now Professor of Photonics and Head of Electronics and Nanoscale Engineering at the University of Glasgow.