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# Laser order boom continues at Coherent

Stock prices nudges all-time high as Coherent lands more big orders for OLED display production.

Coherent has reported record sales in the third quarter of its 2016 fiscal year, along with a continued boom in orders driven primarily by demand for excimer systems used to make organic LED (OLED) displays.



Photo: Coherent.

With industry-style quality control in its production, the reliability of Coherent's "Astrella" ultrafast laser is said to be proving popular with scientific researchers.

At \$218.8 million, the quarterly sales figure represented a new record for the Californian laser firm, although that will soon be eclipsed – CEO John Ambroseo and his executives are expecting to post sales of around \$240 million in the next fiscal quarter ending in September.

And while bookings were down 21 per cent on the extraordinary total of nearly half a billion dollars reported by the company in May, at \$390.8 million in the third quarter they still represent a huge uptick on last year and are further confirmation that a major switch from LCD to OLED screens is under way in the mobile handset industry. Handsets now; OLED TVs still 3-5 years out. The latest quarter included \$240 million in bookings related to flat-panel display (FPD) production – one order was worth more than \$100 million alone.

With Ambroseo telling investors that Coherent remains engaged with a number of customers in the FPD sector, that order boom looks set to continue over the coming months as manufacturers gear up to produce screens for mobile handset launches in 2018.

"The pipeline for the next round of FPD annealing orders is developing as customers refine their market share assumptions and larger-format displays

gain traction," said the CEO, stressing that the current tranche of orders all relates to mobile handset production. Any significant shift to OLED-based TVs, which command a much lower price per unit area of display, remains 3-5 years out, he added.

While the annealing step is the key one for Coherent's sources, other opportunities are also starting to open up. "We are beginning to see orders for other process steps in OLED production including short-pulse lasers for film cutting and excimer lasers for laser lift-off," Ambroseo told an investor conference call.

Laser lift-off relates to a process step where a flexible display is de-bonded from the stiff carrier glass on which it is initially produced – with an ultraviolet laser providing the required energy.

Asked about fiber laser giant IPG's intentions to muscle in on the opportunity in FPD annealing – the Massachusetts company said at its recent investor day that it was engaged with three "top-tier" customers in the industry – Ambroseo said:

"While you can use other types of lasers to anneal [an FPD], you can't get the combination of outcomes that the excimer laser produces."

The CEO explained that this was in major

contrast to laser cutting of metals, where fiber sources have been able to usurp carbon dioxide lasers partly because the cutting process remained the same. Switching to fiber lasers for FPD production would demand a different process, he said.

## Flow cytometry wins

Away from FPDs, Ambroseo said that Coherent had also received some large orders from medical customers, with "key wins" for lasers and sub-systems used in flow cytometry and solid demand for applications in cataract and photocoagulation therapy.

In the materials processing space, although Chinese demand for laser cutting and marking was weak, there was strong demand for more advanced applications – while newer laser technologies also appear to be gaining traction.

"We also had two notable orders for ultrafast laser processing, one for fuel injector nozzle drilling and the other for manufacturing diamond tool heads," said Ambroseo.

In the scientific market orders were down slightly while researchers in Asia and Europe awaited project funding, but the CEO said that Coherent's new "Astrella" ultrafast lasers were proving popular thanks to their ease of use and reliability.

"I can't emphasize the reliability aspect enough," he told investors. "We are confident that this will further improve users' experience while reducing our warranty expenses."

On the impending acquisition of industrial laser firm Rofin-Sinar, Coherent still expects

*continued on next page*



Trading at just below \$100 prior to the latest positive financial results, Coherent's stock price was already close to an all-time high only bettered during the short-lived telecoms boom of 1999-2000, and has doubled in just 12 months.

continued from previous page

## Laser order boom continues at Coherent

the deal to be finalized before the end of the year, and is currently working on the arduous process of gaining regulatory approval from the European Commission.

Rofin's shareholders have already approved the \$942 million deal, while US regulators recently gave it the green light. "We have made steady progress on integration planning and expect to hit the ground running after closing the deal," said Ambroseo.

- The recent order boom from the FPD industry has helped push Coherent's stock

price close to an all-time high. Shortly after releasing its latest quarterly results, the firm was trading at around \$101 – a sharp rise from around \$60 at the start of 2016, and equivalent to a market capitalization of some \$2.4 billion.

<http://optics.org/news/7/7/39>

(All information correct at time of publication.)

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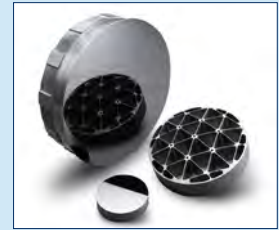
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# Quantum dot start-up UbiQD wins NSF grant for solar windows

Los Alamos spin-out gets SBIR Phase 1 cash to develop coatings based on cadmium-free nanoparticles.

UbiQD, an early-stage producer of cadmium-free quantum dots based in Los Alamos, New Mexico, has won a \$225,000 grant from the National Science Foundation (NSF) to work on optical coatings for generating power from glass windows.

Awarded at the end of June, the Phase 1 grant will support the



Photo: UbiQD.

The UbiQD team celebrates the opening of its new quantum dot manufacturing facility in Los Alamos, New Mexico on July 29. Pictured (l-r) are: board members Dudley McDaniel and Colin Cumming, director Karthik Ramasamy, founder and president Hunter McDaniel, board member Katharine Chartrand, director Aaron Jackson, and director Matt Bergren.

development of windows able to absorb sunlight and re-emit fluorescence at a longer wavelength towards solar cells at the edge of the window.

According to the NSF grant abstract: "This technology hasn't been commercialized yet because previous tint materials typically absorb their own emitted light, limiting efficiency. This project aims to provide a solution to these problems with a novel low-cost window tint material made from quantum dots."

The quantum dots in question are free of toxic cadmium, the metal typically found in such nanoparticles. Instead, UbiQD is working with CuInSeS/ZnS material, said to be both significantly cheaper than CdSe or InP alternatives, although perhaps more importantly with the kind of near-infrared fluorescence that is desired for low-cost solar cells, without causing self-absorption.

"In this SBIR Phase I project CuInSeS/ZnS quantum dots will be optimized for higher photoluminescence efficiency (greater than 50 per cent) and applied as industry-compatible coatings to glass substrates for higher performance," concludes the abstract.

## 'Large opportunity'

UbiQD founder Hunter McDaniel said the award would allow the fledgling company to focus on a particularly large market opportunity. "Our vision is to turn ubiquitous, everyday windows into sunlight harvesters. Think of skyscrapers that power cities," he added.

The quantum dot technology set to feature in those windows was originally developed at the Los Alamos National Laboratory and the University of Milano-Bicocca in Italy, and was recently licensed by UbiQD.

Until winning the grant, the company had been looking at a variety of potential applications in lighting, security, and other markets, but says that it will now focus primarily on the solar window opportunity.

As recently as last month, UbiQD moved into a newly renovated 9000 ft<sup>2</sup> facility in Los Alamos, with the aim of scaling up its manufacturing capacity.

Heading up the manufacturing side is new employee Karthik Ramasamy, who gained a PhD under the supervision of University of Manchester, UK, professor Paul O'Brien – the founder of cadmium-free quantum dot specialist Nanoco Technologies.

Just this week Nanoco announced a licensing deal with chemicals giant Merck that could herald a huge expansion in production of the nanoparticles for display applications.

Thus far, the firm's financial backers have included New Mexico's local Venture Acceleration Fund, and the New Mexico Consortium, which is funded by the state's three major research universities.

<http://optics.org/news/7/8/9>

(All information correct at time of publication.)

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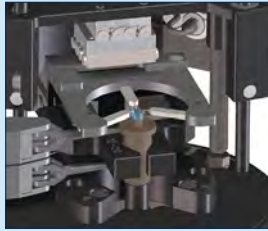
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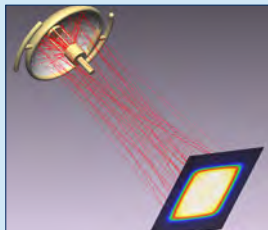
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# Optical probe measures temperatures deep inside the brain

**CNBP project offers new view of links between neuronal condition and drug use.**

Brain temperature is affected by a wide range of external factors, and in turn influences many aspects of animal behavior and health.

One particular class of external agent is stimulant drugs such as MDMA, that can have a pronounced effect on the temperature of several regions of the brain. This makes the measurement of those temperatures a potentially vital avenue of research into the pharmacology and toxicology of the drugs.



Credit: CNBP

*CNBP researcher Stefan Musolino. The optical fiber probe can generate and harness light to detect temperature changes in biological systems.*

A new optical probe developed by a team at the University of Adelaide and the Centre for Nanoscale BioPhotonics (CNBP) might make these measurements easier to obtain from localized areas deep within the brain. The work was published in *Biomedical Optics Express*.

Optical fibers have been tried as a means to probe brain temperature in the past, but usually in the form of relatively large diameter fibers within which Bragg gratings are inscribed, allowing changes to the wavelength of light caused by rising temperature to be monitored.

The new probe aims to provide a less invasive and more effective method, by utilizing a thin layer of rare-earth doped tellurite glass on the tip of a conventional silica optical fiber. This localizes the sensitive area to a thin region at the front of the probe, potentially allowing it to take measurements from specific spatial locations in the brain. It can be interrogated using a portable optical measurement set-up, meaning that measurements could ultimately be performed outside of standard optical laboratories.

"Using this incredibly thin glass fiber we can track the changes in temperature that we see in the brain, allowing us to better understand what is happening across the neuronal and inflammatory pathways," commented Stefan Musolino of CNBP. "What our probe provides is an entirely new method for getting relevant biological measurements out of the brain for further study and analysis."

## Turbo-charge neuroscience research

Rare-earth thermometry as a method of small-scale temperature measurements relies on changes to the emission spectrum of certain ions doped within a host media, as the temperature of that host varies. Comparing the emission intensity of two thermally linked energy levels within the overall spectrum allows the temperature to be assessed, once the device has been calibrated.

CNBP previously proved the concept for biomedical applications, but used bulk optics for coupling into the optical fiber probe and a bench-top spectrometer. The new device is a more compact and potentially clinician-friendly design, requiring no alignment and able to fit on a portable optical breadboard plate.

Testing the device in vivo involved measuring the brain temperature of ambulatory rats over extended periods, alongside body and ambient temperatures. Data indicates that the probe remains capable of delivering accurate readings despite substantial changes to the external ambient temperature.

The next steps will involve looking more closely at the effects of drugs such as MDMA, and on the implantation of multiple probes at different spatial regions of the brain - a potentially significant route to understanding the pathways involved in drug-induced responses.

Future scenarios could see a fully developed probe applied to human brains after traumatic brain injury or stroke, when the brain is extremely sensitive and vulnerable to small deviations in temperature. It could also be utilized for tracking hypothermia in infants during the first hours after delivery.

"Our long term strategy is to take this technology and to develop a multi-functional probe that will let us track not just temperature change, but also other biochemical activity in the brain as well," noted CNBP researcher Erik Schartner. "This has the potential to turbo-charge research outcomes in the field of neuroscience, greatly aiding our understanding of the brain, the most complex and complicated organ in the body."

<http://optics.org/news/7/7/38>

*(All information correct at time of publication.)*

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# Merck licenses Nanoco quantum dots

## German chemicals giant becomes second major player to license cadmium-free nanomaterials in little over a week.

UK-based cadmium-free quantum dot (CFQD) developer Nanoco has signed up its second major customer in the past ten days, with global chemicals firm Merck agreeing to market the technology for displays applications.

Like Taiwan's Wah Hong Industrial, Merck has signed a non-exclusive licensing agreement. Nanoco had previously worked with Dow Chemical on an exclusive basis, but that strategy was abandoned earlier this year.

Under the terms of the latest deal, Merck will pay both a licence fee and royalties on its sales of the CFQDs, which can start with immediate effect. At first those sales will be limited to the materials produced at Nanoco's Runcorn, UK, facility, although Merck is also free to establish its own production facility if market demand is deemed to be sufficient.



Photo: Nanoco Group.

The Merck agreement is the second licensing deal Nanoco has announced with a major global player in a little over a week. On July 22 the Manchester, UK, firm said it had agreed a similar non-exclusive deal with Taiwan's Wah Hong Industrial.

## TV traction

Quantum dots, or nanocrystals, are rapidly gaining traction in televisions as a lower-cost way to improve large-scale liquid-crystal displays (LCDs) image quality close to what is possible with still-expensive organic LED (OLED) technology.

However, most of that growing demand has thus far been met with older cadmium selenide (CdSe) quantum dot materials, with CFQDs emerging more recently as an alternative that is able to meet environmental concerns around the use of cadmium.

Like many heavy metals, most obviously lead, the use of cadmium in manufacturing is generally banned by the European Commission, although various exemptions have been introduced – most notably, as far as photonics applications are concerned, in glasses for microscopy and thin-film CdTe solar panels made by First Solar.

Commenting on the Nanoco deal, the CEO of Merck Performance Materials Walter Galinat said: "With CFQDs a remarkable increase in the color range and a significant reduction in power consumption can be achieved. These cadmium-free quantum dots are eco-friendly and also complement our product portfolio for the display industry."

He added: "The licence agreement with Nanoco will strengthen our position in quantum materials research, for which we laid the foundations by acquiring Qlight Nanotech of Israel last year."

According to its parent company, Qlight had developed rod-shaped

quantum materials that offered the advantage of re-emitting polarized light, something that ought to result in higher-brightness output via the polarizer typically used in the materials stack of a liquid-crystal display.

Nanoco chief Michael Edelman said following the latest announcement: "This agreement with Merck is another major endorsement of the world-class quality of our CFQD technology. We are convinced that Merck can leverage its position in the display industry with these innovative materials."

## OLEDs in handsets; QDs in TVs

Although OLED technology looks set to take over as the primary display type in mobile handsets and other relatively small devices like tablet PCs – as evidenced by a recent boom in orders for Coherent's excimer lasers used in OLED production – analysts at Lux Research do not believe that this take-over will be mirrored in TVs, partly because of rival quantum-dot technology.

Lux reckons that the market for QD-enhanced LCDs will grow at a compound average rate of 60 per cent through 2020, rising from a market value of just \$510 million in 2015 to more than \$5 billion by the end of the decade.

"We expect CFQDs to be a significant player in QD displays," the analyst firm told optics.org last year, adding that although in the past indium phosphide quantum dots tended to deliver a wider linewidth than CdSe, and therefore less "pure" colors, the likes of Nanoco have improved CFQD optical performance by tweaking their compositions.

Inevitably, the eventual market opportunity for CFQDs will depend to some degree on the legislation agreed by the European Commission and European Parliament, institutions that have found themselves in major disagreement over the use of cadmium in microelectronics applications.

• Nanoco's stock price, which had already risen sharply on the London Stock Exchange over the past month, jumped another 4 per cent in value on news of the Merck agreement. Trading at around 75p on August 1, the stock was up from just 40p at the end of June, translating to a market capitalization of approximately £170 million.

<http://optics.org/news/7/8/2>

(All information correct at time of publication.)

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