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Organic light for organic production

Micro-algae have potential to produce numerous biological products, from biofuels to cosmetics. At the International Display Workshop in December, researchers from TU Dresden and Fraunhofer COMEDD will demonstrate a new bioreactor that grows algae using light from an OLED. **Greg Blackman** reports

Researchers at TU Dresden and Fraunhofer COMEDD have developed a bioreactor to cultivate micro-algae using organic light-emitting diodes (OLEDs) as a light source. The reactors, roughly the size of a cigarette packet, could help find algal strains that excel in producing substances like proteins, dyes, cosmetics, biofuels and pharmaceuticals.

The project was funded by the Saxon State Ministry for Higher Education, Research and the Arts, and the prototype bioreactor will be shown for the first time at the International Display Workshop in Japan, from 4 to 6 December.

Felix Krujatz, a researcher at the Institute of Food Technology and Bioprocess Engineering at TU Dresden, said that, currently, only around 15 of the estimated 60,000 strains of algae have been used in biotechnological processes. He feels there is potential for these small bioreactors to screen different algal strains for varieties that make useful bio-products.

Certain strains of micro-algae produce valuable proteins and oils as a natural product of photosynthesis. In order for the algae to grow, though, they need a light source. The researchers used OLED technology, which can be engineered with an emission peak around the absorption range of chlorophyll (650 to 680nm), explained Krujatz. It is also possible to fabricate OLEDs in almost any shape. The organic LEDs are characterised by their flat design, less than 200nm thick, which means they don't heat up as much compared to LEDs. This is important for engineering such a bioreactor; LEDs have to incorporate cooling elements, which limits the design of the reactor.

Krujatz said the reactors can be used to understand how the OLED will affect the algae. 'OLEDs provide homogeneous light because of the 2D light area,' he said. 'When illuminating with LEDs, the cells are forced, because of the point light sources, in light/dark cycles. Nobody knows how this affects the cells.'

> **OLEDs can be pulsed and dimmed easily – another advantage**

OLEDs provide a homogeneous light source, so can be used to research how light/dark cycles affect the cells by switching the OLED on and off. OLEDs can be pulsed and dimmed easily – another advantage of the technology compared to LEDs, says Krujatz. LEDs have a high ground voltage, so can't be dimmed as easily.

Krujatz said the bioreactors can also be used to optimise the bioprocess and investigate parameters such as cell density, how viable the cells are, and how much protein is produced. The cell-specific measurements are made using fluorescent labelling and optical measurement technology. The aim is to get a comprehensive understanding of the process – for instance, to get a better idea of how the algal strains react in terms of biomass growth, chlorophyll fluorescence, and also product formation when the CO_2 content is changed.


Fraunhofer COMEDD

An OLED lighting panel developed at Fraunhofer COMEDD

Krujatz doesn't see OLED technology in its current state as a lighting technology for large-scale algal production. He said that these processes that are optimised in the lab can eventually be replicated in larger reactors, but using other systems. The small bioreactors are to get a better understanding of the process at a laboratory scale.

The group has completed the design of the reactor and now plans to trial various algal growth reactions. ●

PRINTING OLEDS ON AN INDUSTRIAL SCALE

Scientists at the Fraunhofer Institute for Applied Polymer Research IAP in Potsdam-Golm have developed a pilot to print OLEDs as well as organic solar cells on an industrial scale. The scientists worked with mechanical engineering company Mbraun to develop the facility.

OLEDs and solar cells can be printed at the facility from solutions containing luminescent organic molecules and absorptive molecules respectively, which makes printing them onto a carrier film straightforward. Usually, printing OLEDs and solar cells involve vaporising small molecules in a high vacuum, making it very expensive.

Scientists had previously only ever used various printing technologies to design components on a laboratory scale. They can now produce larger sample series, which is advantageous for producing tailored solutions in relatively small numbers.

'We're now able to produce organic components under close-to-real-life manufacturing conditions with relative ease. Now we can translate new ideas into commercial products,' said Armin Wedel, head of division at the Fraunhofer IAP.

At the heart of the plant is a robot that controls different printers. OLEDs are applied to the carrier material one layer at a time, using a variety of starting materials. This produces a very homogenous surface that creates a perfect lighting layer.

'We're able to service upscale niche markets by offering tailored solutions, as we can apply the organic electronic system to customers' specifications, just like in digital printing,' said Wedel.

Industry experts say that printed OLEDs has promise of becoming a billion-dollar market. 'The focus in Germany and Europe is on OLED lighting because this is the home market for large companies such as Osram and Philips,' said Wedel.

Dr Martin Reinelt, CEO of Mbraun in Garching, added: 'The manufacturing facility will help secure competitive advantages in this particular segment of the market.'