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Celebration as IoP Lands £2.7 million in new funding

The Institute of Photonics at the University of Strathclyde has won £2.7 million of funding from the EPSRC to develop an entirely new core technology based on micro-LED arrays.

The research will have applications in an emerging industry worth billions of dollars annually.

The award has secured a four-year basic technology programme to develop indium gallium nitride ultra-violet emitters in an array format. This is effectively a miniaturised ultraviolet projector for use in studies of organic materials and in controlling their chemistry and biochemistry.

The university had originally developed blue emitters but the focus on ultra-violet opens up exciting applications such as mask-less lithography, an image source for liquid solid rapid prototyping and analysis of chemical and bio-chemical samples. The technology has been developed with support from Scottish Enterprise's Proof of Concept fund.

Commenting on the award Professor Martin Dawson, Associate Director of the Institute, said: "We submitted the proposal last May. It was one of around 130 which were whittled down to a shortlist of 20 which went to full proposal. Only eight were selected for funding."

Other partners in the project include the Pure and Applied Chemistry Departments at Strathclyde University, the University of Sheffield Electrical Engineering Department as well as Heriot Watt and Imperial College.

The consortium is looking to develop emitters for wavelengths between 280 and 440 nm. Such sources will allow high-frame-rate programmable pattern exposure with high spatial, spectral and temporal resolution. Dawson points out that there is a very targeted intent behind the research:

"Science works hand in hand with technology so there is always a need for new instruments and measurement capabilities. These technologies are a vehicle or platform for a range of technologies and developments."

The main beneficiaries of the project include those involved in biomedical imaging, and producers of light-emitting polymers. Biophotonics, micro-science and organic semiconductors are also likely to benefit.

The display and lighting industry worldwide is already being revolutionised by the advent of high brightness, light emitting diodes (LEDs). Gallium nitride (GaN) materials technology has been used to provide devices at the blue end of the spectrum and the same technology forms the basis of white light LEDs.

Very high powered devices producing about one watt of output are now becoming available. GaN technology is predicted to grow into at least a $3 billion market by 2005.

These conventional GaN macroLED devices have an active area of approximately 350 microns diameter but they have a number of drawbacks which the microLED device seeks to overcome. MicroLEDs are more compact, have better efficiency, have better beam quality, achieve faster operating speeds and permit better viewing angles than their macro counterparts. They have the potential to make a major impact in areas as diverse as displays, communications and optical bio-chips.

The new project will create MicroLEDs with a thousand micro-emitters per square millimetre. These will function in a similar way to a standard LED but on a much smaller scale.

A matrix addressing scheme allows the emitters to be addressed individually and in this format they have produced about 100 microwatts each, although their maximum output power potential has yet to be fully evaluated. In addition, the sapphire substrate can be machined so that microlenses are produced aligned with each microLED emitter. This means that the beam from each emitter can be focused by its own microlens.

The individual micro-LEDs can be switched on and off very quickly which could enable these devices to be used for communications. The microLEDs also have great potential as bio-sensors where the light emitted from each element of the array could excite chemical markers for the detection

Scottish Enterprise

and identification of diseases. This could be used in fluorescent tagging of DNA. Currently this is done by laser and requires technology costing around £50,000. There is a real chance here to mass produce disposable DNA readers allowing GPs to do the testing instead of laboratories. Lab-on-a-chip micro-arrays, high resolution printing and sensing are other areas that are being explored by the partnership. In bio-medicine there are possibilities of using the microLEDs to restore sight to people blinded by opaque corneas. “These possibilities are the starting point for the project,” says Professor Dawson. “These are our best guesses as to what will be possible. The work to date on proof of concept has attracted a lot of interest from inside the industry. The core project is an enabler and then we will look at complementary projects.”

The Institute of Photonics has built a strong reputation in the area of wide-bandgap gallium nitride materials and devices. Its focus is on the growth of optoelectronic quality materials, the design and characterisation of material and device structures and the practical implementation of novel devices.

For more information, go to: www.photonics.ac.uk