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EDITORIAL

Micro-pixellated LEDs for science and instrumentation

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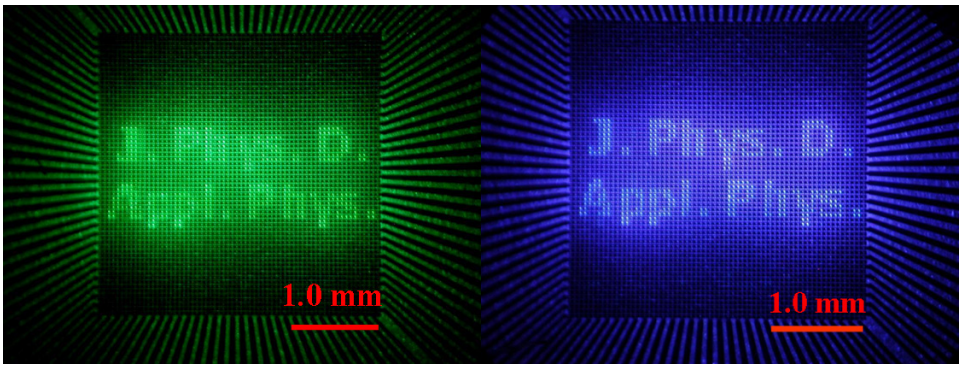
This Cluster Issue of *Journal of Physics D: Applied Physics* highlights micro-pixellated gallium nitride light-emitting diodes or 'micro-LEDs', an emerging technology offering considerable attractions for a broad range of scientific and instrumentation applications. It showcases the results of a Research Councils UK (RCUK) Basic Technology Research programme (http://bt-onethousand.photonics.ac.uk), running from 2004–2008, which has drawn together a multi-disciplinary and multi-institutional research partnership to develop these devices and explore their potential.



Examples of GaN micro-pixel LEDs in operation. Images supplied courtesy of the Guest Editors.

The partnership, of physicists, engineers and chemists drawn from the University of Strathclyde, Heriot-Watt University, the University of Sheffield and Imperial College London, has sought to move beyond the established mass-market uses of gallium nitride LEDs in illumination and lighting. Instead, it focuses on specialised solid-state micro-projection devices the size of a match-head, containing up to several thousand individually-addressable micro-pixel elements emitting light in the ultraviolet or visible regions of the spectrum. Such sources are pattern-programmable under computer control and can project into materials fixed or high-frame rate optical images or spatially-controllable patterns of nanosecond excitation pulses. These materials can be as diverse as biological cells and tissues, biopolymers, photoresists and organic semiconductors, leading to new developments in optical microscopy, bio-sensing and chemical sensing, mask-free lithography and direct writing, and organic electronics. Particular areas of interest are multi-modal microscopy, integrated forms of organic semiconductor lasers, lab-on-a-chip, GaN/Si optoelectronics and hybrid inorganic/organic semiconductor structures.

This Cluster Issue contains four invited papers and ten contributed papers. The invited papers serve to set the work in an international context. Fan *et al*, who introduced the original forms of these devices in 2000, give a historical perspective as well as illustrating some recent trends in their work. Xu *et al*, another of the main international groups in this area, concentrate on biological imaging and detection applications. One of the most exciting prospects for this technology is its compatibility with CMOS, and Charbon reviews recent results

with single-photon detection arrays which facilitate integrated optical lab-on-chip devices in conjunction with the micro-LEDs. Belton *et al*, from within the project partnership, overview the hybrid inorganic/organic semiconductor structures achieved by combining gallium nitride optoelectronics with organic semiconductor materials. The contributed papers cover many other aspects related to the devices themselves, their integration with polymers and CMOS, and also cover several associated developments such as UV-emitting nitride materials, new polymers, and the broader use of LEDs in microscopy.

Emission patterns generated at the end of a multicore image fibre 600 μm in diameter, from article 094013 by H Xu et al from Brown University.

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