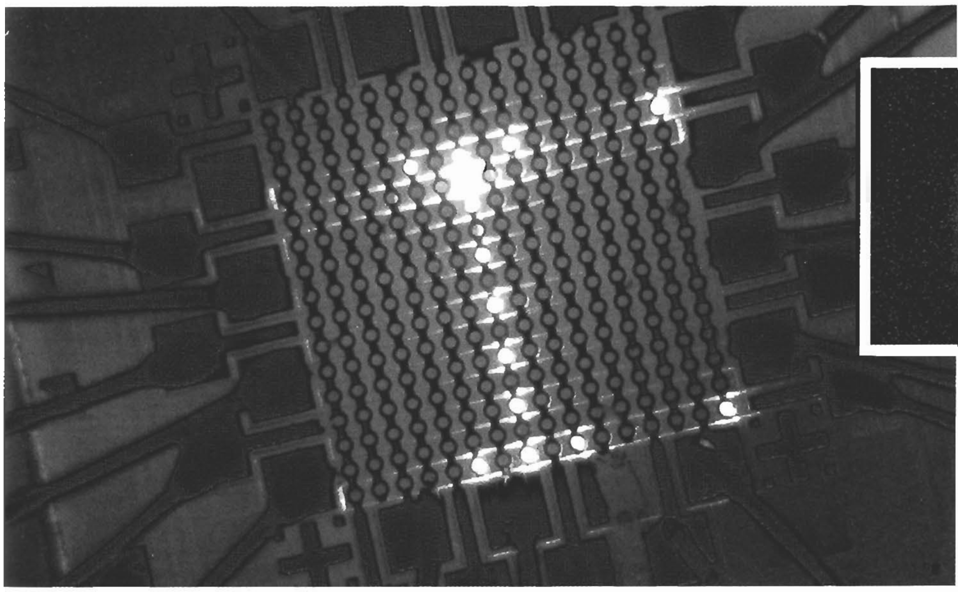

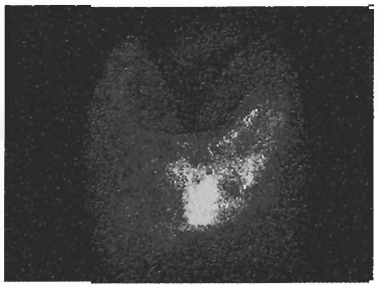

LEFT:
False colour image of a tooth showing decay under the surface not visible to the naked eye. Taken using multi-photon imaging techniques.

LEFT MAIN:
16x16 gallium nitride microLED array, elements individually addressable, showing the letter "I" lit up.

IoP working to bridge the gap

Maggie Stanfield profiles the work of the Institute of Photonics

"PHOTONICS is the science of generating and harnessing light as well as other forms of radiant energy whose quantum unit is the photon." So says the American National Standard of Telecommunications glossary.

It's a useful definition up to a point, but it does not, of course, delve into the practical or the research applications of what can be done with that light.

Without being a quantum physicist, a full understanding of photonics is probably not within reach, but the outcomes of scientific research will impinge on our lives whether in industry, as professional end-users, or as the individual beneficiaries of that technology.

The Institute of Photonics, part of the University of Strathclyde, seeks to bridge the gap between university research and industrial requirements in the area of photonics research and development. Ultimately, it seeks to create a commercial bias so that academic work can be translated into the marketplace.

"We work across a broad range of photonic source development," says the Institute's Business Development Manager, Tim Holt. "We believe that successful and effective technology transfer is best supported by providing an environment, facilities and expertise where the whole range of activities from strategic research to supporting spin-out companies can all flourish."

The Institute works with all-solid-state lasers, semiconductor materials and devices and their applications in biophotonics, optical communications, materials processing, and a range of other areas. Success can mean meeting new research and technical challenges, and building intellectual capital in the process, delivering projects to specific deadlines for individual industry partners, or the commercialisation of technology developed in the Institute though spin-out, licensing or other technology transfer routes. The Institute is structured into four research teams: applications; gallium nitride materials and devices; laser system development; and semiconductor optoelectronics materials and devices.

"Most of our applications work concerns the use of ultra-fast lasers for biomedical imaging, spectroscopy and materials processing," says Holt. "Technology advances in the development of solid-state light sources are creating better performance and reliability in compact, low maintenance packages. Together, these advances are opening up exciting new application opportunities which this team focuses on."

The light source forms an often crucial element within the total solution, both in imaging and materials processing, using non-linear multi-photon absorption. For example intact teeth and living cells can be imaged using multi-photon techniques with minimal invasive damage. The Institute is working closely with the University's Centre for Biophotonics towards the exploitation of modern optical techniques specifically for biomedical research. The Centre is a unique facility and was created to foster world class interdisciplinary research between life scientists and laser physicists in the area of high-resolution optical imaging. Current research at the Institute also includes investigation into the production of and applications for microLED arrays made from gallium nitride. "Conventional gallium nitride macro LED devices have a number of drawbacks which our microLED device seeks to overcome. MicroLEDs are more flexible, more compact, have better efficiency, better beam quality, faster operating speeds, better viewing angles, than their macro counterparts," Tim Holt adds.

These compact devices have the potential to be used for a wide range of applications, including micro-displays, bio-sensors, where the light emitted from each element of the array could excite chemical markers for the detection and identification of diseases or chemical or biological substances, and optical communication devices.

With the dawn of the human genome project, the Institute's research has the capacity to make the technology fast, simple and informative. He continues, "An important aim of much of this work has been to develop disease detection systems with the longer term goal of disease prevention or cures. At present much of the technology behind these advances is cumbersome, expensive, time consuming and requires highly skilled users in order to obtain the required results."

High-power laser research focuses on enhancing the capabilities of advanced ultrashort pulse laser systems by extending the average output powers to the 10-100W range. Now developing research that will overcome the difficulties of thermal distortion at these power levels, the Institute is having success with intra-cavity adaptive optic elements, thin-disc crystal geometry and quasi-cw pumping techniques.

contact: www.photonics.ac.uk