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Lasers, mirrors and fog at the Institute of Photonics

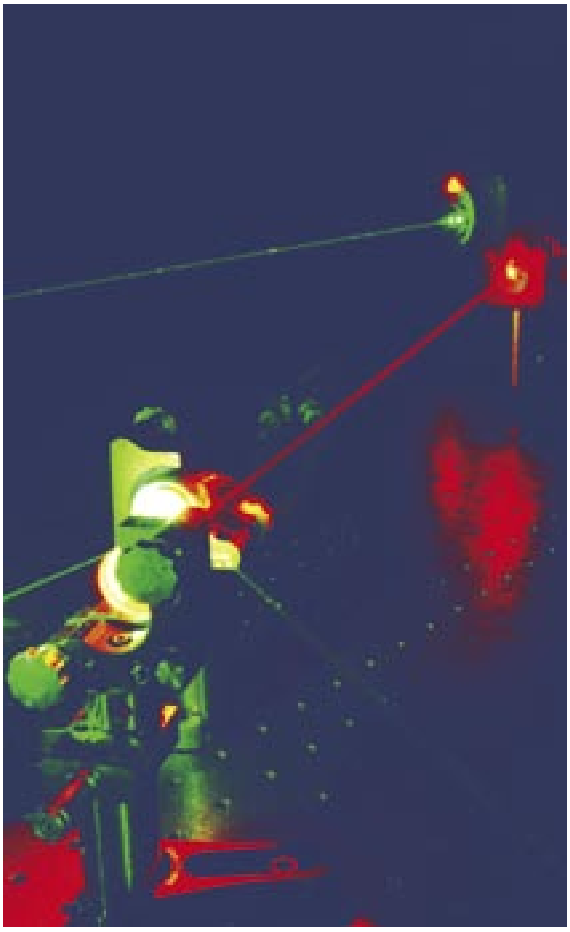
It may not quite be smoke and mirrors, but it certainly involves mirrors and fog or, more accurately, lasers, mirrors and fog. The combination is part of the innovative work being carried out at the Institute of Photonics at Strathclyde University in Glasgow.

Developers of laser-based products are frequently forced to make compromises because a source providing light at the optimum point in the spectrum is not readily available. Cost-effective technology that offers greater flexibility in laser wavelengths has the potential to make real improvements in existing products and provide the basis for a raft of new ones.

This technology exists in the form of "Vertical External Cavity Surface Emitting Lasers" or "VECSELs". Although the concept has been around for a number of years, the challenge has been to move from the theoretically possible to the commercially practicable.

In simple terms, what an optically-pumped VECSEL is able to do is to take the beam from another laser, usually on another microchip, and convert its wavelength and, at the same time, improve its beam quality. This is a development of lower power electrically excited VCSEL (Vertical Cavity Surface Emitting Laser) technology which uses mirrors to sandwich an active semiconductor region to produce the laser beam. The optically pumped VECSEL uses another laser to pump the device so enabling higher output power than is possible from the electrically driven VCSEL, converts the wavelength of the pump laser to the one which is required and produces better beam quality due to the removal of one of the attached mirrors and its replacement by an external mirror. Hence putting the "E" in VECSEL.

Recently a team from the Institute of Photonics at the University of Strathclyde in Glasgow, Scotland and the Optoelectronics Research Centre from Tampere in Finland achieved high-power, continuous-wave operation at red wavelengths for the first time. This breakthrough could have



Pioneering laser technology used by the Institute of Phototonics

important implications, for instance, in photodynamic therapy (PDT) for the treatment of cancer.

Patients being treated with PDT have a photosensitiser injected into the tissue. This remains inert until activated by light generally in the red wavelength. Diode or dye lasers may be suitable, but the ideal solution is a compact, high power solid-state source with high beam quality at red wavelengths, performance which can be provided by VECSEL technology.

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It is not just medical applications that can benefit from VECSEL technology. Just over a year ago in Dec 2003 the Institute of Photonics joined a consortium of UK companies and universities to develop an optical platform for free-space-optical (FSO) communications in a program called ALFONSO.

"This is a very exciting project funded by the Department of Trade and Industry," explains the Institute of Photonics' new chief executive Tim Holt. "We will be helping to develop network access using laser transmitter-receivers rather than fibre-optic cables.

"CableFree Solutions, who are also in the consortium, already produce a range of laser-based networks. We can offer lasers which work at wavelengths which are less limited by atmospheric conditions. Eventually all lasers will be affected by weather, basically by dense fog, but some wavelengths perform much better than others."

The Institute's contribution comes in the form of optically pumped VECSEL which operate in the mid-infrared, providing greater penetration in adverse atmospheric conditions than existing systems that use other wavelengths. This will be combined with adaptive optics from the Institute and Durham University to compensate for turbulence in the atmosphere that distorts and deflects the laser beam.

Laser links are becoming increasingly popular as a cost-effective way of providing internet and network access in places where it is, for instance, impractical to dig up the ground to lay fibre optic cables or where microwave links are seen as a health hazard.

Current generation FSO systems, however, are limited in range and reliability by weather effects, the most severe being thick fog. In practice, this means though FSO works well at short distances, with typical link availability of 99.999 per cent at 500m, reliability drops rapidly with distance – for example only 99.9 per cent at 1km in the UK. 'ALFONSO' promises to deliver better performance in terms of range, link availability, and bandwidth. The target is 10Gbp/s over several kilometres.

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