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The next big thing?

Biophotonics shows great promise but to fulfil its true potential, biologists, physicists and engineers will need to work harder to understand each other.

Biophotonics — a realm where optical technology meets the worlds of medicine and biology — is arguably one of the best examples of how photonics can directly benefit and touch our lives.

The past 20 years have seen photonics already revolutionize the capabilities of communications and data storage. Over the next 20 years, photonics will probably transform healthcare too, with a new breed of light-based diagnostic equipment and treatments arriving in clinics and hospitals.

In fact, if one looks around, the start of this transformation can already be seen. Today, photonics is already at the heart of many treatments ranging from laser-assisted *in situ* keratomileusis (LASIK) eye surgery to help correct vision[1], to next-generation dental equipment[2], various forms of cosmetic skin treatment and hair removal[3] and photodynamic therapy for treating cancer[4].

And this short, non-comprehensive list does not include the wave of diagnostic tests based on cutting-edge imaging techniques. For example, optical-coherence tomography[5] can now map the retina with unprecedented resolution and identify eye disorders; fluorescence microscopy can study cell behaviour; and the latest endoscopic 'camera pills' can check the health of your intestine[6].

The one thing that all these examples, and many others besides, show is that photonics is an incredibly powerful enabling technology when it comes to healthcare. Who would have dreamt ten years ago that it would be possible to create a miniature digital camera pill that once swallowed can record, in real-time, high-quality images of your insides, by exploiting the latest advances in CCD-sensor, white-LED and wireless-transmitter technology? However, just such a device is now routinely used in Europe[6].

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And *in vivo* imaging solutions in the future could be even more sophisticated and take place on the nanoscale thanks to the latest research in quantum-dot bioprobes. Researchers around the world are now busy engineering nanostructured semiconductor probes that are carefully designed to provide optimum fluorescent, magnetic and biochemical properties for tracking drug delivery, the progression of diseases and cellular activity in the body[7].

So what is it about photonics technology in particular that makes it so appealing and attractive for medical applications? The answer is that the use of light brings with it a host of intrinsic benefits. From a surgical point of view, a laser beam is non-contact and sterile. It can also be focused to a very small spot enabling precise localized treatment, and thanks to the use of absorbing dyes and wavelength tunability, the treatment can be highly selective. From a diagnostic point of view, optical sensors and imaging techniques are often non-invasive, high-resolution and information-rich.

Unsurprisingly, given these tantalizing characteristics and the size of the healthcare market, investment in biophotonics is vibrant with a glut of commercialization, growth, clinical testing and acquisitions taking place in the area. Advanced Medical Optics (AMO), one of the leading suppliers of equipment for LASIK eye surgery, has announced that it expects revenues to top $1 billion in 2007 (ref. 8).

And following the decline of the telecoms market at the turn of the century, many investors, entrepreneurs and scientists within photonics have now turned their eyes to biophotonics as an avenue for their talents.

However, for the sector to fulfil its true potential it is going to require more than just money and technological advances. Perhaps the most important challenge is learning to bridge the divide between biologists and physicists and engineers. Biophotonics will ultimately only succeed if scientists from these disciplines interact more and work hard to understand each other's requirements and how they can help each other. Although this certainly isn't the easiest gap to bridge and will require efforts from both sides, the potential rewards to society surely justify the time and effort.

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