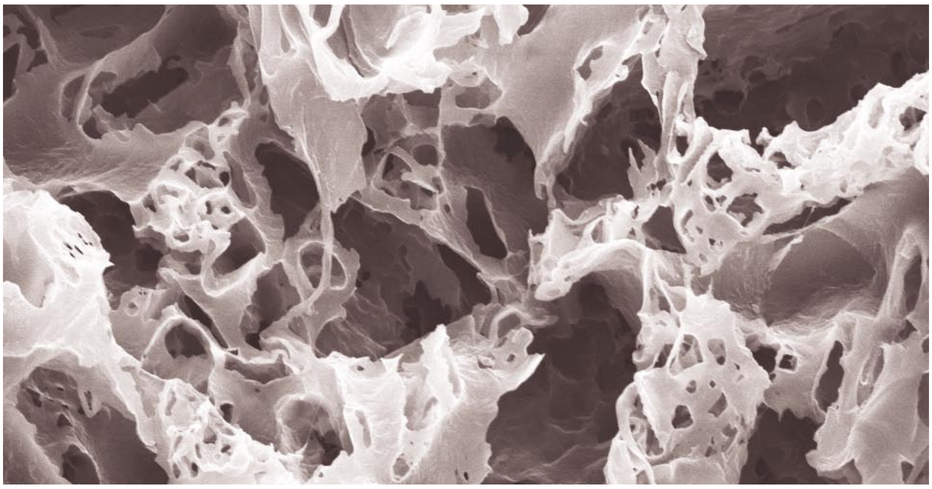
NPL
National Physical Laboratory

Health *Matters*

A National Measurement Newsletter

Spring 2006 | Issue 1



A polymer scaffold made from polycaprolactone

Taking tissue to the next level

UK Healthcare providers are facing the challenge of maintaining a high quality of life for an increasingly ageing population whilst coping with the inevitable affects of ageing and disease. The global shortage of transplantable tissue is especially a pressing issue since people are dying whilst on waiting lists.

Tissue engineering using tissue scaffolds offers a novel route for repairing damaged or diseased tissues.

Tissue scaffolds are biocompatible support structures that act as cell 'nurseries'. In an ideal situation healthy cells harvested from the intended patient are cultured on the temporary scaffold housing, akin to a sponge, to form a block of functional living tissue. The use of a patient's own cells counter any possible tissue rejection or immuno-suppresant drug problems. Alternatives are also being explored using donated cells or those obtained from animal sources. In the future this 'grow your own' approach could potentially be used to grow complete, functional organs.

The structure and properties of the scaffold are critical to ensure normal cell behaviour and the successful growth of healthy tissue, yet they have been poorly characterised until now. NPL's Paul Tomlins is working in collaboration with Brighton University and Queen Mary College (University of London) on a project to establish standards and test methods for the characterisation of tissue scaffolds. The availability of approved standards for tissue scaffolds mean that they will no longer be the tools of the experts but a usable, mass-market treatment.

For further information on this project please contact:

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See and hear Paul Tomlins's presentation on Tissue Scaffolds and cell-based sensors at www.npl.co.uk/mnt/dec05

Inside:

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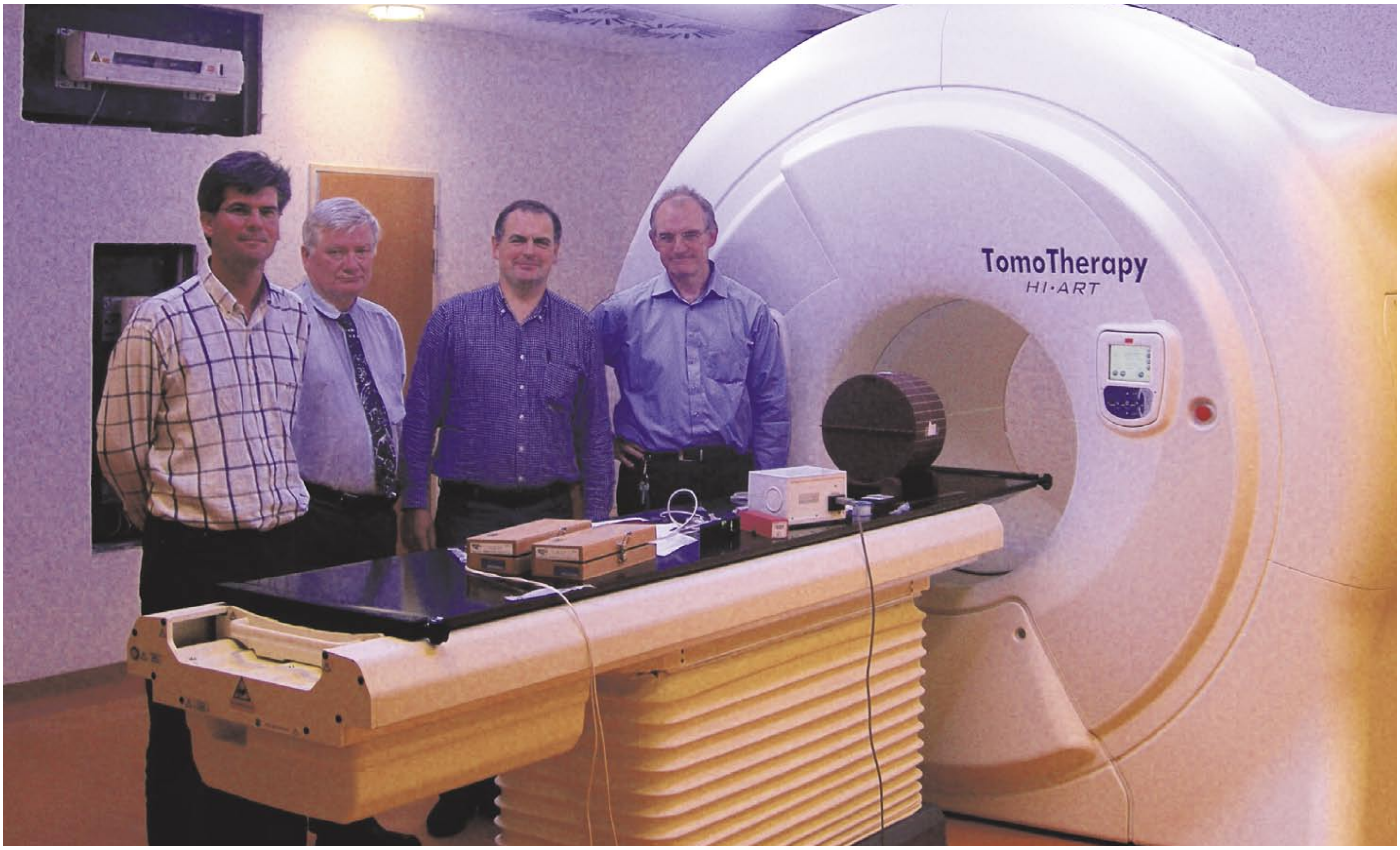

Simon duane and his collaborators at the UCL Hospital, Brussels.

Advancing cancer therapy with traceable dosimetry for tomotherapy

Helical tomotherapy, a new and particularly effective way to treat cancer patients, is coming to the UK this year. But the newly introduced machines could not be calibrated in accordance with UK codes of practice.

NPL identified this risk and is researching new techniques to support its safe and accurate delivery in UK hospitals. The machines used to deliver the treatment are incompatible with existing codes of practice that hospitals should follow on how to provide accurate, traceable doses. They are unable to produce the required 10 cm x 10 cm reference beam for calibration purposes.

__Tomotherapy machines__ are a cross between a CT scanner and a conventional clinical linear accelerator. They can deliver highly complex dose distributions over the whole body in one treatment. They could be considered as the most sophisticated form of IMRT (intensity modulated radiotherapy) currently available. The first tomotherapy machine in the UK is now being commissioned at the private Cromwell Hospital in London with NHS hospitals expected to follow later this year.

NPL proposed the use of alanine dosimeters to measure doses which are traceable to NPL's primary standard for absorbed dose.

It is working with tomotherapy machine manufacturers, OSL (Oncology Systems Limited), the UK distributor for TomoTherapy Inc, and Cromwell Hospital to ensure that the commissioning of the first tomotherapy machine in the UK includes calibrations that provide traceable doses.

Simon Duane and his NPL colleagues at the Clinique Universitaires Saint-Luc Hospital in Brussels had conducted the first practical trials of the system by December 2005. At the same time, ZNA Middelheim of Antwerp conducted comparative trials. The results were presented to the Belgian Hospital Physicists Association meeting in Ghent in January. According to the treatment plan used, the expected doses showed very good agreement, to better than 2%.

NPL is confident that this will not only provide a solution to traceable doses for tomotherapy, but also a means of making traceable measurements in typical clinical treatment plans for conventional IMRT systems.

For further information please contact Simon Duane
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Sound cancer treatment

In the UK, more than 5,000 people are diagnosed with cancer every week. NPL is working with the Institute of Cancer Research (ICR) to develop better cancer treatments that will improve patient survival rates.

Adam Shaw from NPL's Acoustics Team is completing a part-time secondment with the ICR's Therapeutic Ultrasound Team to advance the measurements for HIFU (High Intensity Focused Ultrasound) systems.

HIFU is a non-invasive treatment that uses the power of ultrasound to destroy deep-seated malignant tissue with pinpoint accuracy. It reduces the need for treatments that impact the entire body, like chemotherapy, lowering recovery times and patient discomfort.

The joint research will include temperature measurement in tissue and tissue substitutes, determination of ultrasonic attenuation and absorption properties of tissues, and nonlinear propagation effects.

The joint work has already produced a report that addresses the requirements for HIFU measurement standards within the framework of the International Electrotechnical Commission. This report identifies a number of factors important in the advancement of HIFU where there is knowledge sufficient to produce a Committee Draft within two years. These include how to measure ultrasound power, the specification of acoustic field parameters and the definition of thermal dose.

For further details please contact
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This report
(NPL Report DQL-AC 015)
can be downloaded from
the NPL website at
www.npl.co.uk/publications

Ultrasound power measurements for HIFU

NPL now offers ultrasound power measurements and calibrations traceable to National Standards up to at least 200 W (acoustic power).
This extended service is offered for focused and unfocused transducers in the frequency range 1 MHz to 5 MHz with typical overall uncertainties of ±6% at the 95% confidence level. Measurements are also possible outside this range with increased uncertainties.

All measurements are made in compliance with IEC61161.

Radiotherapy news in brief

Restoring trust in treatments

In late 2005, hospitals using radioactive ophthalmic applicators to treat some eye cancer conditions began to find discrepancies between their calibrations and those reported by the manufacturer. The manufacturer investigated and admitted the problems with its calibrations. Hospitals were understandably reluctant to treat patients and looked to NPL to recalibrate the applicators.

With patients waiting on the outcome, NPL recognised the importance of getting these calibrations done quickly, reliably and accurately. All hospitals that have notified NPL that they have this problem have been booked in for urgent calibrations, scheduled to be completed before the end of March.

For further information please contact Graham Bass
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Record turn-around time for calibrations

NPL is supporting cancer treatment in the UK by completing photon beam calibrations in record time. The calibrations are a key service for external beam radiotherapy centres. Calibrating the ion chambers on which patient dosimetry depends usually takes 11 weeks. NPL completed the job in four. NPL hopes to maintain this level of service during the Spring 2006 calibration period running in April and May.

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'The sound of music'

Almost 9 million people in the UK suffer from a hearing impediment or complete deafness, and this figure is set to rise as the number of people over 60 years old increases. Current technology has enabled sound to be amplified providing limited hearing capability to the hearing impaired. However, most users are unable to enjoy an extensive range of hearing experiences such as listening to music. Cochlear transplants provide a solution for some people.

Current implants consist of an electrode placed inside the ear and an external box (containing a microphone) behind the ear, which are quite bulky. Scientists at NPL are working in collaboration with the Institute of Nanotechnology and the Nanotechnology group at Cranfield University to develop a miniaturised version, based on a proven NPL concept, which can fit inside the cochlea (pictured below).

NPL's prototype implant is self-powered and resembles a comb with bar-shaped elements that are coated with a piezoelectric material that flexes generating an electrical pulse. Each element is tuned to resonate individually at different frequencies giving users manual control over what they hear. This means background noise can be tuned out.

At two centimetres squared, the prototype is still quite large and a final product may be up to 10 years away. But, research into the biocompatibility of the implant and performance of its protective coating is taking place. When finished, this new device should enable users to enjoy a wider range of sounds. Its compact nature makes it less obtrusive, doing for users what contact lenses did for spectacle wearers. Angela King, of the Royal National Institute for the Deaf, said the research shows huge promise.

"Although we will not know for some years the true potential of the approach being investigated, it is in our view worth exploring to the full."

For further information on this research please contact
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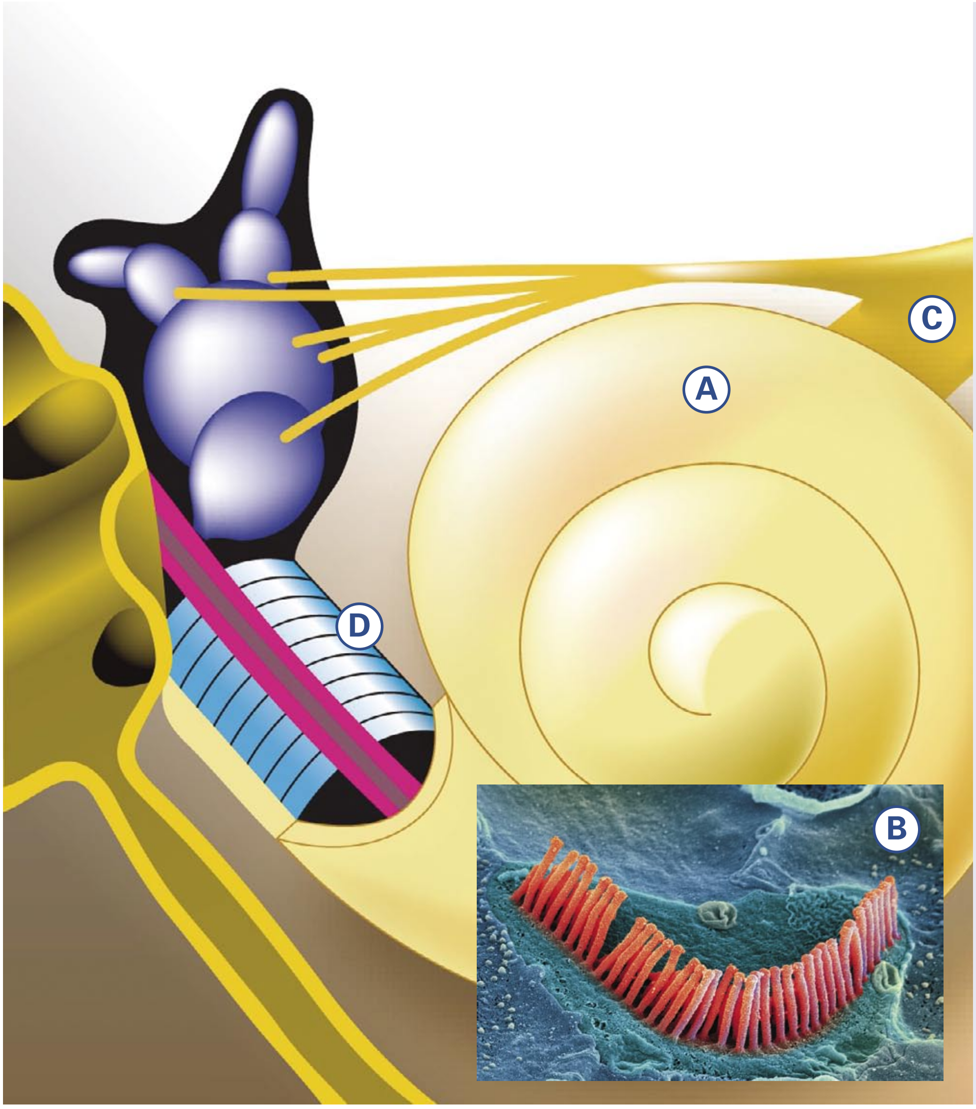


How does a cochlear implant work?

The cochlea (A) is the hearing part of the inner ear. It contains an inner chamber which has thousands of small hair cells (see inset B), each of which has tiny hair-like structures that project into the cochlear fluid. Sound waves cause these structures to vibrate triggering an electrical signal that is sent to the brain via the auditory nerve (C) resulting in 'sound'.

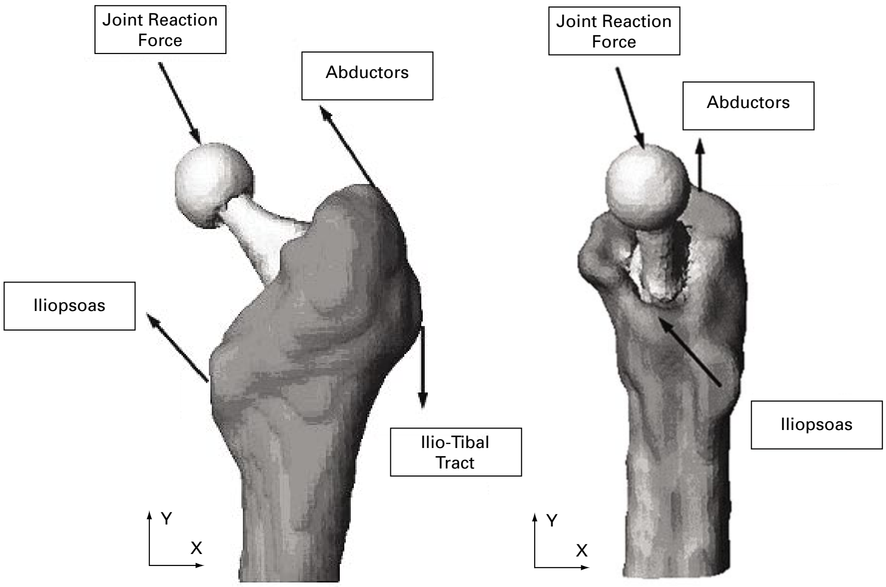
Damage to these tiny hair cells can cause deafness. NPL's cochlear implant (D) will bypass damaged hair cells by generating this electrical signal. However, for this to work the auditory nerve must be functional.

Helping the NHS to bear the load

Over 2 million people in the UK are affected by osteo-arthritis or osteoporosis. More than 90% are over 60 years old, and this will rise in line with life expectancy. By 2010, the number of sufferers in the UK is expected to rise by 20% . The projected increase in total hip replacement (THR) operations will add £250 million to NHS costs.

Osteo-arthritis and osteoporosis increase the risk of bone fractures. Implant design or materials failure could cause 12% to 20% of THR patients to require corrective surgery within a year due to these fractures. Preventative measures are weak because it is difficult to determine accurately, and in advance, the post-operative performance & structural integrity of implants and bone.

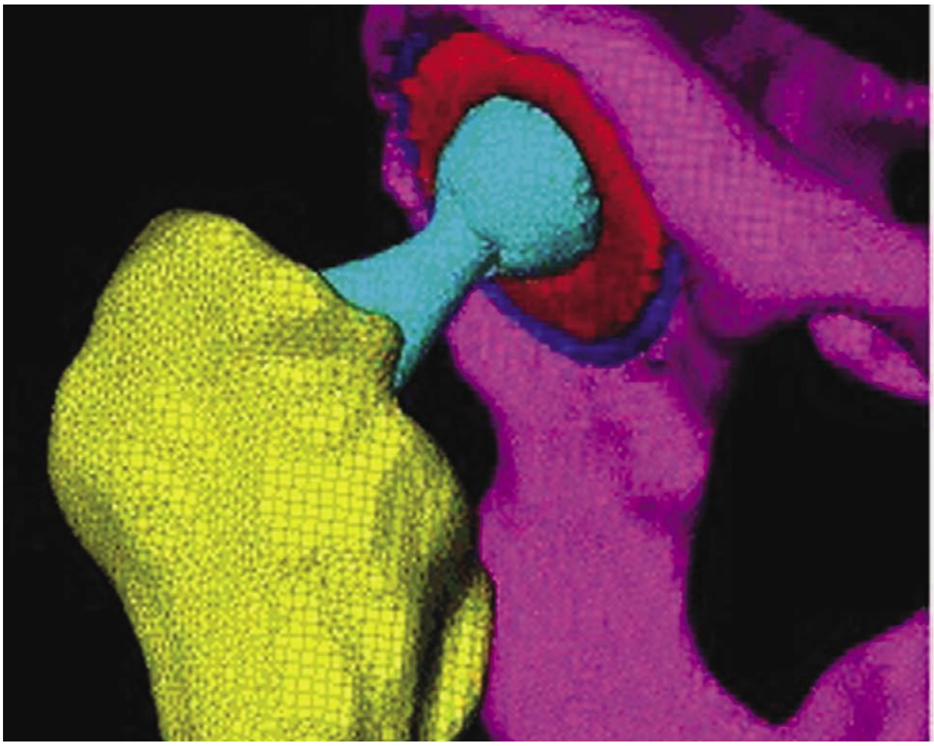
An NPL collaborative project set out to explore whether 3D computer models generated from patient specific computed tomography (CT) scans could be used to assess bone strength and predict how successful the integration of bone and implants had been.



The location of each of the loads used in the simulations

The project took two years to complete and involved four orthopaedic industry partners, plus an NHS hospital and the University of Exeter. During the study real human femurs, prosthetic implants and simulated 3D computer models were subjected to a variety of load-bearing tests and the results were compared.

The results showed good correlation between the real bone or implant and the corresponding computer simulation. The project partners and NPL are now considering further work to build confidence in the use of 3D modelling to determine bone strength and structure as well as predicting, quantitatively, how well a particular implant will perform in an individual's body.



An FE mesh of the postoperative hip, in vivo

For further information on this project, please contact the Project Manager Sekhar Chakravorty
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NPL collaborative projects enable companies to research solutions to specific measurement problems by accessing NPL's expertise and equipment in a cost-effective manner.

If you would like to receive further information or have a suitable project you would like to arrange, please contact the Materials Enquiry Point by telephone (020 8943 6701), fax (020 8943 7160) or e-mail: materials@npl.co.uk

Pain free measurements

Leg ulcers are a chronic condition affecting 1 in 100 people in the UK and costing the NHS about £500 million a year to treat. Through a collaborative project, NPL and Isotec Imaging are advancing the treatment of leg ulcers by developing a portable calibrated instrument for quick non-contact measurements of open wounds.

A stereo image of a leg ulcer taken with MAVIS

The incidence of chronic wounds is increasing along with diabetes and our ageing population. Leg ulcer wounds heal slowly and monitoring is essential in determining progress and specifying suitable treatment. Doctors use a simple technique to measure the wound area and volume on a weekly basis to decide if it is healing. By placing a transparent sheet on top of the wound, a physician traces the wound perimeter and counts the squares inside the line. The volume is measured by filling the wound with saline from a syringe – the amount dispensed is the wound volume.

In addition to being painful, these invasive procedures are inaccurate, slow, and carry a cross-infection risk. MAVIS (Measurement of Area and Volume Instrument System), developed by Isotec Imaging, is a portable system that avoids these issues. The system measures area, volume and swelling, and records colour non-invasively.

MAVIS takes an image through its left and right "eye" - a stereo adapter on a camera with two lenses. It then scans both images pixel by pixel and matches them up.

MAVIS uses commercially available cameras and optics that can be easily afforded by a range of clinics. To effectively monitor wound healing, it is essential that these measurements are consistent between instruments. NPL is providing the calibration and measurement expertise needed to deliver the necessary consistency and accuracy.

Together with Isotec Imaging, NPL is developing flesh-like textured surfaces to be used in the calibration process. At present, dimensional calibration is carried out by recording images of grids and colour and matched to colour charts. Images are digitised and analysed using a special algorithm that recognises common points in image pairs. However, dimensional accuracy affected by optical distortion and colour reproduction, may vary between cameras and with time. The goal is to design and fabricate dimensional calibration artefacts with flesh-like textured surfaces and to investigate the factors affecting accurate colour recording. The project will also investigate possible improvements to the optical design, recording and display.

A calibrated instrument will be used in pilot clinical trials at the Royal National Hospital for Rheumatic Diseases NHS Trust to set up best practice guidelines for traceable measurements.

Calibration and measurement traceability are important factors in health care and this project ensures medical practitioners can use MAVIS with confidence.

For more information on the MAVIS calibration project please contact
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NPL calibration artefacts and MAVIS

This collaborative project is funded through the DTI Measurement for Innovators programme - a programme designed to promote innovation by linking industry with the world class expertise and facilities contained within the UK's National Measurement Institutions. To find out more about the Measurement for Innovators visit www.npl.co.uk/measurement_for_innovators

Healing ulcers using ultrasound

NPL's Acoustics Team is helping to investigate whether physiotherapy ultrasound will accelerate the healing of 'hard to heal' venous leg ulcers.

A selection of the physiotherapy ultrasound systems being used in the leg ulcer study

Venous ulcers are wounds that are thought to occur due to improper functioning of valves in the veins. They are the major cause of chronic wounds, occurring in 70% to 90% of cases.

With calibrated therapy machines, wound recovery can be compared with the applied treatment mode. Clinicians can make an assessment about whether the speed of healing varies with output power and excitation mode.

The clinical trial, led by the University of York, will explore low dose ultrasound administered weekly for 12 weeks - for between five and 10 minutes - used in conjunction with compression therapy. The results will be compared to those achieved when using compression therapy alone.

Carefully controlled clinical trials are the fastest and safest way to determine whether experimental treatments or new methodologies of known therapies are effective. Calibration of therapy equipment is a must in eliminating any variability and establishing a baseline measurement for comparisons.

Before the trial started, NPL accurately calibrated and characterised 40 commercial physiotherapy systems to selected clauses of the International Electrotechnical Commission (IEC) standards. The NHS Research and Development Health Technology Assessment Programme (HTA) is sponsoring the VenUS III: Ultrasound for venous leg ulcers *(VenUS III; ISRCTN 21175670)* trial.

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Have your say on a major NPL research programme!

VAM
valid analytical measurement

NPL needs your input to provide a programme of activities to improve medical devices, drug delivery and the health impacts of pollution. The input of experts in the healthcare sector is essential to ensure the programme meets all of the UK's analytical needs.

Analytical measurements are vital to the UK economy - they ensure product quality, monitor impact on the environment and satisfy legal requirements. It is estimated that the UK spends approximately £8 billion on analytical measurements every year.

The Valid Analytical Measurement - Physical (VAM-P) programme underpins the reliability and integrity of analytical measurements. It supports the development and maintenance of reference methods and standards, and allows analytical measurements among trading partners to be compared.

The VAM-P programme runs in three-yearly cycles, with the next programme due to start in October 2006. Key areas of the programme directly relevant to the healthcare industry are:

- Surface characterisation of materials used in implants and other medical devices
- Physical and chemical analysis of particles and nanoparticles (in ambient air, from industrial and vehicle emissions etc.) to support epidemiological studies
- Determination of the compositional structure of fibres and nanoparticles used for drug delivery or other medical applications

Your input into the formulation of the next programme will help to steer the content to support your changing measurement needs and challenges.

The proposed programme is available for comment on the VAM-P formulation website: www.npl.co.uk/formulation/vam. Please visit this site to give your feedback, and to find more detailed information on the VAM-P programme.

For further information, contact the VAM formulation team directly
020 8943 6443
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A dose of UV

Many people in the UK suffer from skin disorders such as eczema, psoriasis, dermatitis and vitiligo and undergo treatments through exposure to ultra violet (UV) light at specialist phototherapy centres. Affected areas are treated using either full body cabinets or units for specific areas such as hands or feet. The doses must be optimised to ensure treatment is effective whilst protecting against skin burns and cancer. This requires accurate calibration of the measurement devices used to monitor dosage.

A recent comparison found the calibration factors for meters used in UV doses varied by large amounts between different treatment centres. The result is that doctors can no longer deliver accurate doses of UV light, making it impossible to ensure continuity in treatment regimes if a patient has to move to another phototherapy centre. It also makes it difficult to assess any increased skin cancer risk for that patient and prevents doctors knowing precisely the doses needed to cure their skin conditions.

In an effort to increase the quality and effectiveness of UV treatments in the UK, NPL has undertaken a more systematic investigation. This will try to identify the causes of the variation between treatment centres and produce a Best Practice Guide to provide help and guidance on how best to characterise UV measurement devices and UV sources.

'A patient wih localised scteroderma'
Courtesy of Harry Moseley, University of Dundee

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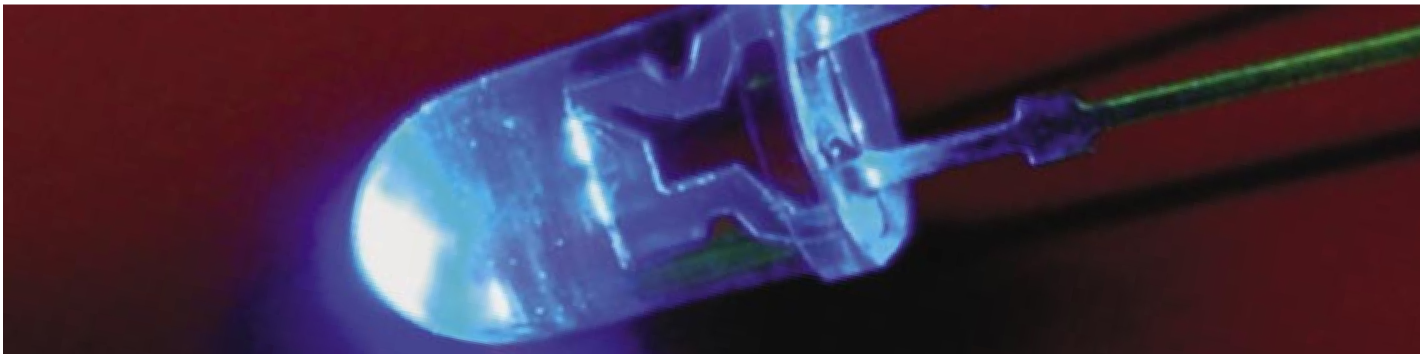

Blindingly bright LEDs

NPL is investigating whether high brightness LED (light emitting diode) lights cause eye damage.

High brightness LEDs are an increasingly common sight on roads, railways, seas and in the air. They make very effective signals and beacons due to their ability to be made into recognisable clusters, low power consumption, good energy efficiency, and availability in a wide range of colours.

The lumen output on new LEDs is rising considerably, so that the applications are spreading to the general lighting arena, as well as security and health applications.

With the increase in output, there are questions being raised about the safety of these products. Does the LED (or LED product) cause damage to the skin or retina of the eye?

Along with the general safety queries, there is discord about the most appropriate measurement standard to be applied. Currently there are two standards which cover LEDs – IEC 60825 laser safety standard and CIE S009 photobiological safety lamps standard. Although both derive their safety limits from the same international recommendations, the methods for assessments vary in each one.

Experts are coming to agreement about the best approach to take, so that scientists and manufacturers alike can ensure the LEDs under test will not cause damage to people who use the products.

NPL's optical radiation measurement team *has provided reference standards, equipment and even complete optical radiation measurement facilities to research labs in the UK and across the globe. These support a wide range of industries, including textiles, optoelectronics, lighting, transportation, aerospace, food and defence.*

The team is leading the world in: space and earth observation – of particular importance for environmental monitoring; sensory metrology – how people perceive objects and environments; and photon metrology – useful for quantum cryptography and quantum computing.

For further information please contact Paul Miller
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Making quality biopharmaceuticals

Measurement scientists at NPL have identified a way to improve the accuracy of tests, which identify whether new drugs meet quality guidelines.

Biopharmaceuticals – biological molecules used as therapeutic agents – are used in the prevention and treatment of a wide range of critical conditions. They are the focus of considerable activity in the UK where they represent almost 50% of the market for recently licensed pharmaceutical products.

This surge in growth has been coupled with the need for these drugs to be quality controlled and regulated. The quality of all new drugs must be equivalent and traceable to the original 'gold standard' version that passed extensive clinical trials. Valid quality control methods must demonstrate that subsequent batches are essentially the same as the clinical trial batches.

However, in a trial covering 21 UK laboratories, NPL found that differences in testing techniques were causing variation in the results produced. NPL is working with these laboratories to improve the measurement reliability and to help these laboratories ensure that the measurements meet the regulators needs.

NPL's biotechnology group are continuing research to validate the use of Circular Dichroism (CD), a technique already used extensively in industry, which could provide a robust and rapid way to test the structure of biopharmaceuticals accurately.

The right way to test: Circular Dichroism

Circular Dichroism is a spectroscopic technique that measures the difference in the absorption of circularly polarised light by a molecule. Any differences are caused by the structural asymmetry of the molecule.

The functioning of biopharmaceuticals is intrinsically linked to their structure so reliable testing techniques must be able to produce information on the 3D structure of the protein.

CD is one of the few techniques that can provide information on the 3D structure of proteins in solution. It enables sensitive measurements to be taken reasonably quickly on a routine basis. Although widely used there has been little work to develop objective means to discriminate between CD spectra.

An NPL project funded through the DTI's Measurements for Biotechnology (MfB) programme, identified and addressed the limitations of this technique. The result was a robust, well-validated set of methodologies for CD ensuring it could be used accurately.

The project involved developing and validating mathematical approaches, which accelerated the process of identifying whether batches of biopharmaceuticals could be classified as "compliant" or "non-compliant" with increased accuracy. It also involved investigating and ensuring the accurate transfer of this validated methodology between laboratories, critical to achieving a good state of calibration for the instruments used in the technique.

The result was a Code of Good Practice, which was presented to the regulatory authorities around the UK and worldwide which helps ensure all parties involved in the evaluation of new biopharmaceuticals are working to an agreed and approved process.

For further information please contact the biotechnology team
020 8943 6880
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Medical biosensor videocasts available online!

The Micro and Nano Technology (MNT) Measurement Club is the first NMS club to introduce videocast presentations with synchronised audio recording from their live meetings.

The aim of 'The Measurement and Characterisation of Medical Biosensors' meeting was to review and discuss measurement and characterisation requirements and issues in developing biosensor systems for medical applications. Medical biosensor researchers and developers were privileged to see various presentations describing a range of biosensor techniques, their applied measurement challenges, associated analytical techniques, and recent advances in the medical biosensors market. Outcomes of this meeting will be used to help establish a framework for the evaluation and characterisation of biosensors, contribute to the formulation of future NMS biotechnology projects and define activities to address key measurement issues raised.

View the medical biosensor videocasts at the NPL website: www.npl.co.uk/mnt/dec05
For further details about the MNT Measurement Club please contact
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'Cooking' with molecules

Medical researchers will be able to learn new tricks of their trade quicker with an innovative online tutorial launched by NPL and the National Institute for Medical Research.

Described as a 'cookbook' of how to get started in single molecule research, this reference tool helps educate researchers, who may find it daunting to use new molecular techniques that improve our understanding of biological processes at the molecular level - potentially leading to better medical diagnosis and treatment.

The tutorial will help ensure more patients benefit from the findings of molecular science by increasing the number of people trained to use new tools that have emerged from advances in lasers and optical detectors. Techniques such as optical tweezers and single molecule fluorescence are powerful ways of dissecting molecular behaviour that can often provide information unattainable by more conventional "bulk" measurements. The number of people trained to use them limits their value and the tutorial has been established as a resolution.

The online tutorial is interactive and includes image maps, videos and simulations. It is focussed on the molecular motor proteins discipline, where many of these techniques originated.

Molecular motors are biological "nanomachines" and are the essential agents of movement in living organisms. A motor is a device that consumes energy in one form and converts it into motion or mechanical power. Many protein-based molecular motors convert chemical energy into mechanical energy.

For further information please contact The Biotechnology Team
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View the online tutorial at www.npl.co.uk/biotech/tutorial

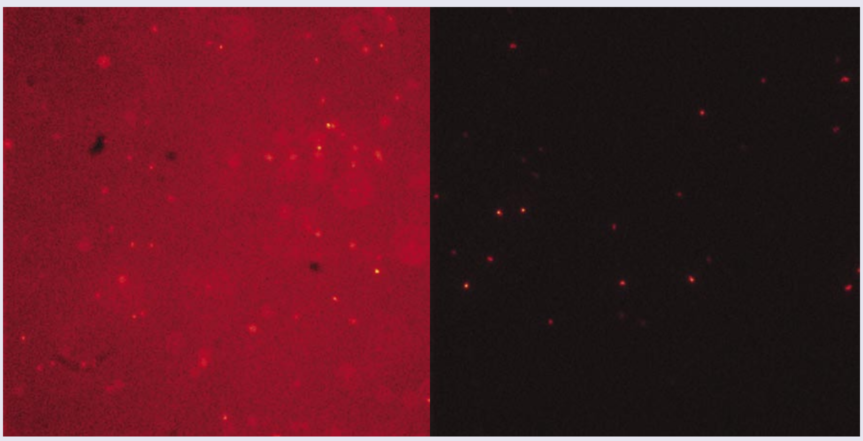

Figure1 - A sample of fluorescent beads in water visualised by epifluorescence (left) vs. TIRF.

Total Internal Reflection Fluorescence (TIRF) is an imaging technology that can visualise single molecules in living cells. It is a form of fluorescence microscopy where excitation light is largely confined to a very small volume close to a surface. TIRF can be applied (to visualise cell signalling and measure the distances of objects with high resolution). For example, in figure 1, out-of-focus beads make it difficult to identify any processes taking place in the epifluorescence image. In contrast, the TIRF image is sharp, and focussed because only beads nearest the cell surface are excited.

Acoustic shock: Hazards of call centres

Acoustic shock is a problem experienced by call-centre operatives and other telephone users, especially those with headsets. Loud and/or startling noises - electronic or otherwise - in the ear cause a variety of psychological and physiological problems, which could lead to various forms of illness, absenteeism, and claims against employers.

The Communication Workers Union receives hundreds of complaints each year from call centre employees on this topic, and they represent only a small fraction of all call-centre operatives in the UK. Out of court settlements totalling over £2M in the UK and over £10M worldwide have already been made.

An initiative called the Acoustic Safety Programme, supported by the CWU (Communication Workers Union), TUC (Trades Union Congress), HSE (Health & Safety Executive) and industry, has been set up to help deal with the problem and was launched at NPL at a conference co-organised by the Call Centre Managers Association last November.

Opening the Acoustic Safety Conference at NPL, Lord Hunt, Minister for Health and Safety, stressed the importance of controlling noise at work and protecting the hearing of Britain's one million call centre workers:

"Taking action early can prevent these problems," said the minister, "the most important advice for call centres is to have a traceable reporting system for headset users, and that headsets should have built-in protection against high noise levels."

Further presentations from NPL's Richard Barham, CWU, and others specialists were also included, and a number of sponsoring suppliers displayed a range of devices designed to suppress or capture acoustic shocks.

To learn more about the Acoustic Safety Programme visit www.acousticshock.org or contact Richard Barham 020 8943 6725 richard.barham@npl.co.uk

If you would like further information on any aspect of **Health Matters,** *please contact:*
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NPL Measurement Surgeries: Empowering UK industry

UK companies are facing the tough challenge of global competition, under increasingly stringent regulatory requirements. Businesses need accurate measurement in order to manage effectively – NPL aims to help the UK compete successfully on national and international platforms.

Our innovative regional surgeries offer you the chance to review your measurement needs on a one to one basis with an NPL expert and access a number of funding initiatives aimed at overcoming company measurement issues. Through this sharing of knowledge, we hope to tailor our future R & D programmes to meet industry needs.

The events are free to attend, but registration is required. An appointment system will ensure you are matched with the expert most appropriate to your particular needs.

Future surgeries are planned for the following market sectors:

- **Biotechnology**
- **Environment**
- **Medical**

If you would like to attend a surgery or suggest a theme not mentioned above, please register your interest at www.npl.co.uk/measurement_surgeries/

Exclusive event
Oxford V Conference 2006
26 - 28 June 2006 at NPL

This international event happens every four years and will be in the UK this summer! NPL's Optical Radiation Measurement Club (ORM) and the Council for Optical Radiation Measurement (CORM) announce a three-day conference focussing on Optical Spectrometry. The conference is intended to bring together people with interests in spectrophotometry, appearance, fluorescence and advances in technology.

For further details and to register please visit: www.oxford-v.npl.co.uk

Forthcoming events

www.npl.co.uk/events

15th Meeting of the Intelligent Sensing Program (ISP) Sensors Knowledge Transfer Network
26 April 2006
IEE, Savoy Place, London
www.sensorsktn.com

4th Meeting of the Nuclear Spectrometry Users' Forum
23 May 2006
NPL, Teddington

DC & LF Club:
Data converters - characterisation and performance optimisation
7 June 2006
NPL, Teddington

Optical Radiation Measurement Club Meeting
28 – 29 June 2006
NPL, Teddington

Humidity Measurement and Calibration course
17 – 18 July 2006
NPL, Teddington

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