EUROPEAN COMMISSION

Community research

Projects from the first call for proposals (2003/2004)

New and Emerging Science and Technology

NEST

INFORMATION PACKAGE

POLICY SUPPORT AND ANTICIPATING SCIENTIFIC AND TECHNOLOGICAL NEEDS

Opening the frontiers of tomorrow's research

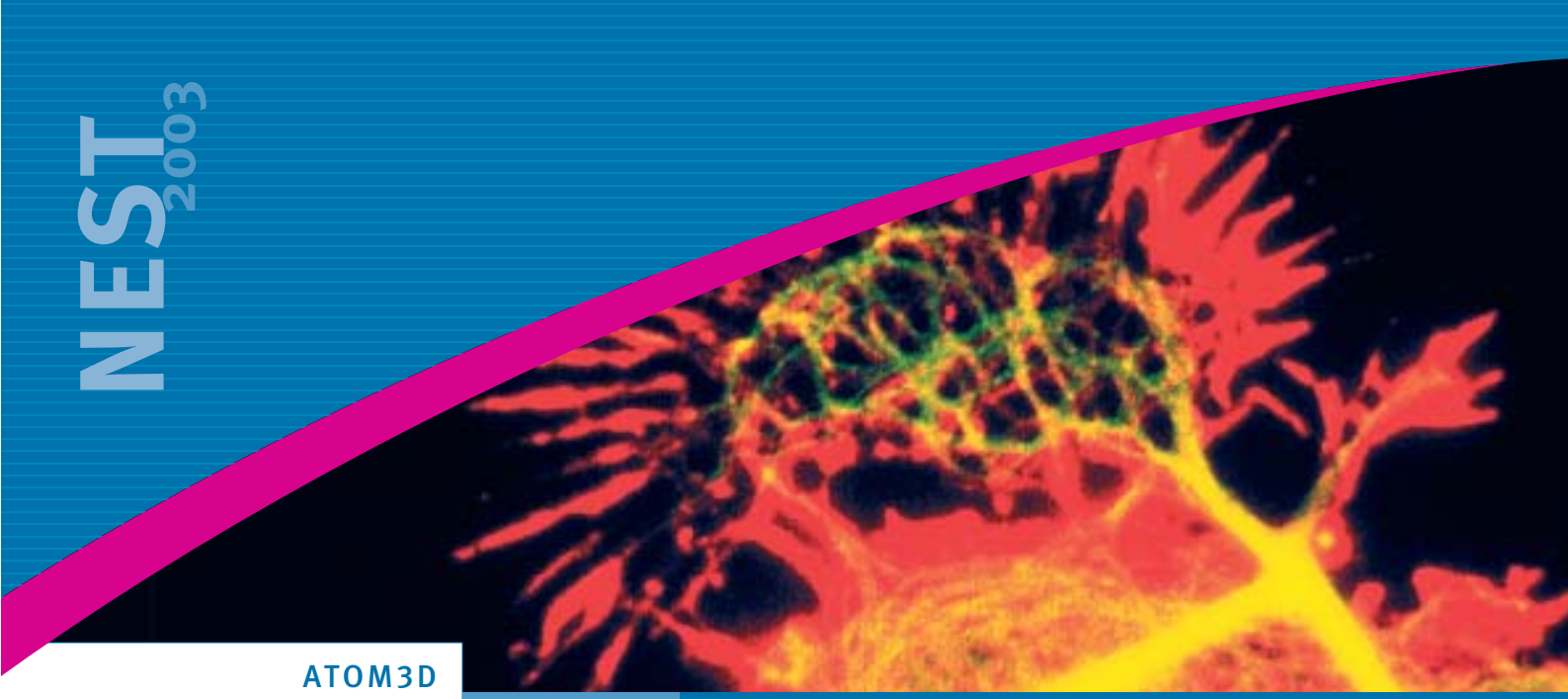
NEST (New and Emerging Science and Technology) is a new activity in the Sixth Framework Programme (FP6). It aims to support unconventional and visionary research with the potential to open new fields for European science and technology, as well as research on potential problems uncovered by science.

NEST is designed to be flexible and interdisciplinary research is encouraged. There are no restrictions on the scientific fields to be addressed except that the research carried out under NEST should cut across or lie outside the thematic priority areas. NEST will not support projects which simply cannot find their home in one of FP6's thematic priorities.

When making research proposals, it will be up to researchers to demonstrate convincingly to independent evaluators that the objectives represent a very significant challenge, that the potential impact of the work is extremely high, and that the approach is truly innovative.

NEST involves three complementary action lines, each contributing to the overall goal of improving European anticipation of future scientific and technological needs.

www.cordis.lu/nest



ATOM3D
NEST ADVENTURE

Being able to grasp tiny objects without physically touching them has many applications for handling delicate biological structures such as living cells. © Roche

Bright future for optical tweezers

Optical tweezers are tightly focused laser beams used to grasp and manipulate tiny objects such as single cells. In this ambitious NEST project, scientists from seven countries will extend tweezer technology to allow particles as small as molecules to be trapped, sorted, transported and even assembled into artificial crystals. In particular, these techniques will have applications in microfluidics, the technology which allows biochemical tests to be done with minute quantities of fluid – the so-called 'lab on a chip'.

Optical tweezers were invented by US physicists in the 1980s who discovered that a tightly focused laser beam could be used to trap microscopic objects, from 0.1 micrometres to tens of micrometres in size. Being able to grasp, move and rotate tiny objects without physically touching them has many applications for handling delicate biological structures such as living cells and their components, and has obvious implications for nanotechnology.

But the dexterity with which objects can be held depends ultimately on the wavelength of the laser light which is still not much shorter than a micrometre. Much finer tweezers will be needed if viruses and even single molecules are to be held. And physicists would dearly like to be able to handle multiple objects at the same time and place them anywhere they wish.

ATOM3D, coordinated by Kishan Dholakia of the University of St Andrews in Scotland, is an ambitious NEST project to create a whole new range of optical manipulating tools, with numerous applications in molecular biology and miniaturisation technology. Its seven partners bring a wealth of expertise in laser optics, electronics, microbiology, microfluidics and microfabrication.

Conveyor belt of light

The first priority of the project is to investigate how optical traps – the jaws of the tweezers – can be formed on nanometre scales, typically a thousand times smaller than today's traps. This part of the project, led by the Institute of Photonic Sciences in Barcelona, will try two approaches that should work in theory but which have not yet been demonstrated experimentally. One makes use of so-called 'evanescent' waves to trap particles in a 100 nanometre layer behind a reflecting surface. Another will investigate how interference holograms can be used to create not only multiple traps on nanometre scales but also an optical 'conveyor belt' to transport trapped particles.

A second work package, led by the University of St Andrews, will focus on 'tailoring the optical landscape', in other words, creating traps of any desired size, shape and number. Until recently, the only

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The seven partners involved in the project bring a wealth of expertise in laser optics, electronics, microbiology, microfluidics and microfabrication. © VIB

ATOM3D
NEST ADVENTURE

AT A GLANCE

Official title
Advanced techniques for optical manipulation using novel 3D light field synthesis

Coordinator
United Kingdom: School of Physics and Astronomy, University of St Andrews

Partners
- *Denmark: Risø National Laboratory*
- *France: Thales Research and Technology*
- *Czech Republic: Institute of Scientific Instruments, Academy of Sciences of the Czech Republic*
- *Hungary: Biological Research Centre, Hungarian Academy of Sciences*
- *Spain: Fundació Privada Institut de Ciències Fotòniques*
- *Sweden: Göteborg University*

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Duration
36 months

Project Cost
€ 2 083 969

EU Funding
€ 1 699 310

Project reference
Contract No 508952 (NEST)

Web: http://www.cordis.lu/nest

way to trap more than one object at a time was to switch the beam rapidly between multiple sites, a feat that has been likened to a circus performer spinning plates on poles. More recently, diffractive optics have been used to make multiple, though static, traps. The team's aim is to improve commercial devices known as spatial light modulators (SLMs) in the hope of being able to rapidly mould the shape of the laser beam to create multiple traps of any desired form at any time.

Optically bound matter

They will also look at exploiting the well-known phenomenon of Brownian motion (the random jiggling of particles by molecules of the supporting medium) to move objects from one place to another and also to sort objects of different characteristics. Even more ambitiously, the team will investigate 'optically bound matter', artificial crystals of particles held together by light rather than the normal molecular forces.

New optical tweezers could be able to handle and move particles as small as molecules.

The third major area of study concerns microfluidics, the technology of manipulating fluids on the nanometre scale – a kind of plumbing complete with valves, pumps, mixers and other devices. It has particular application in biomedical testing. A team led by Hungary's Biological Research Centre will build on the results from other parts of ATOM3D, to use optical tweezers to fabricate, assemble, operate and power microfluidic devices. An early application will be a microscopic 'lab on a chip' which can study the growth of individual cells by optically moving them between different environments.

Each work package will itself be multidisciplinary, drawing on the expertise of several partners. The project will finish with a public workshop to which other stakeholders in molecular trapping will be invited. Members of the consortium will also take part in workshops organised by complementary EU projects.

SIXTH FRAMEWORK PROGRAMME

BIODEFENCE
NEST ADVENTURE

Antibody fragment producing lactobacilli binding to beads covered with the appropriate antigen – an adhesin from Streptococcus mutans.

Countering bioterrorism with passive immunisation

In the event of a bioterrorist attack, exposed populations would be completely unprotected because there are no products available for rapid vaccination. The BIODEFENCE project aims to engineer bacteria 'generally regarded as safe' to produce toxin-neutralising antibodies in the intestinal mucosa. Administered via food or drinking water, the bacteria should confer quick protection. Although developed to counter weapons of bioterrorism (anthrax and botulism), the approach could be applied much more widely.

The recent anthrax scare in the USA has enhanced public concern about bioterrorism, highlighting the absence of quick, effective ways to protect exposed populations. Antibiotics act only against sensitive bacteria (as opposed to viruses or bacterial toxins), and for many pathogens there exists no safe, effective vaccine licensed for public use. When a vaccine is available, multiple doses are required to build up, over months, a sufficient level of immunity. Selected at-risk groups (e.g. soldiers) can be vaccinated preventively, but conventional vaccination is inadequate for quick protection of large populations in an emergency.

Conventional vaccines rely on 'active' immunisation, i.e. the use of an antigen to stimulate antibody production by the vaccinated subject. Another approach, sometimes used in emergency situations, is 'passive' immunisation: administration of ready-made antibodies. But this is a costly solution, requiring mass production and purification of antibodies under strict quality control, and the treatment must continue as long as high antibody levels are to be maintained.

BIODEFENCE is a three-year project based on an idea that may revolutionise passive immunisation: engineering bacteria 'generally regarded as safe' (GRAS) to produce toxin-neutralising antibodies at the site where they are needed. The project focuses on bacteria that naturally colonise the human intestinal mucosa and on the toxins of two mucosal pathogens: the agents of anthrax and botulism. The protective GRAS bacteria could be mass-produced at low cost and added to food or drinking water. Hopefully they would persist in the mucosa and confer protection over an extended period.

Proof of concept

The expertise of the five BIODEFENCE partners (based in Sweden, Estonia, Spain, the Netherlands, and the USA) spans a wide range of life-science disciplines and molecular techniques. A prime objective will be to achieve proof of concept. This will be done with a laboratory strain of lactobacillus, genetically modified to produce antibodies targeting the botulism toxins or a component of the anthrax toxin (a plasmid-based expression system is

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The recent anthrax scare has enhanced public concern about bioterrorism.
Crystal structure of the anthrax lethal factor. © Informations Sekretariat Biotechnologie

BIODEFENCE
NEST ADVENTURE

AT A GLANCE

Official title
Rapid induction of passive immunity against weapons of bioterrorism using transformed GRAS (generally regarded as safe) micro-organisms

Coordinator
Sweden: Karolinska Institutet

Partners
- *Estonia: University of Tartu*
- *Spain: Consejo Superior de Investigaciones Cientificas*
- *The Netherlands: Lactrys Biopharmaceuticals BV*
- *USA: University of Alabama*

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Duration
36 months

Project Cost
€ 2 062 360

EU Funding
€ 1 120 086

Project reference
Contract No 508912 (NEST)

Web: http://www.cordis.lu/nest

already available). An animal model will be used to test the ability of these modified bacteria to confer protection against anthrax or botulism.

In parallel, partners will develop and optimise the approach for use in humans. One task is to select strains of human gastrointestinal lactobacilli that persist in the human digestive tract, are suitable for genetic manipulation, and readily colonise the intestinal mucosa (to be demonstrated on human volunteers). Another important task is to develop a food-grade gene expression system offering all necessary safety guarantees. This notably means ensuring that marker genes conferring antibiotic resistance are eliminated from the expression constructs and that the antibody genes remain confined within the GRAS bacteria. Once this work is done, an animal model will be used to test expression of the antibody-encoding genes, expression-construct stability, and protection.

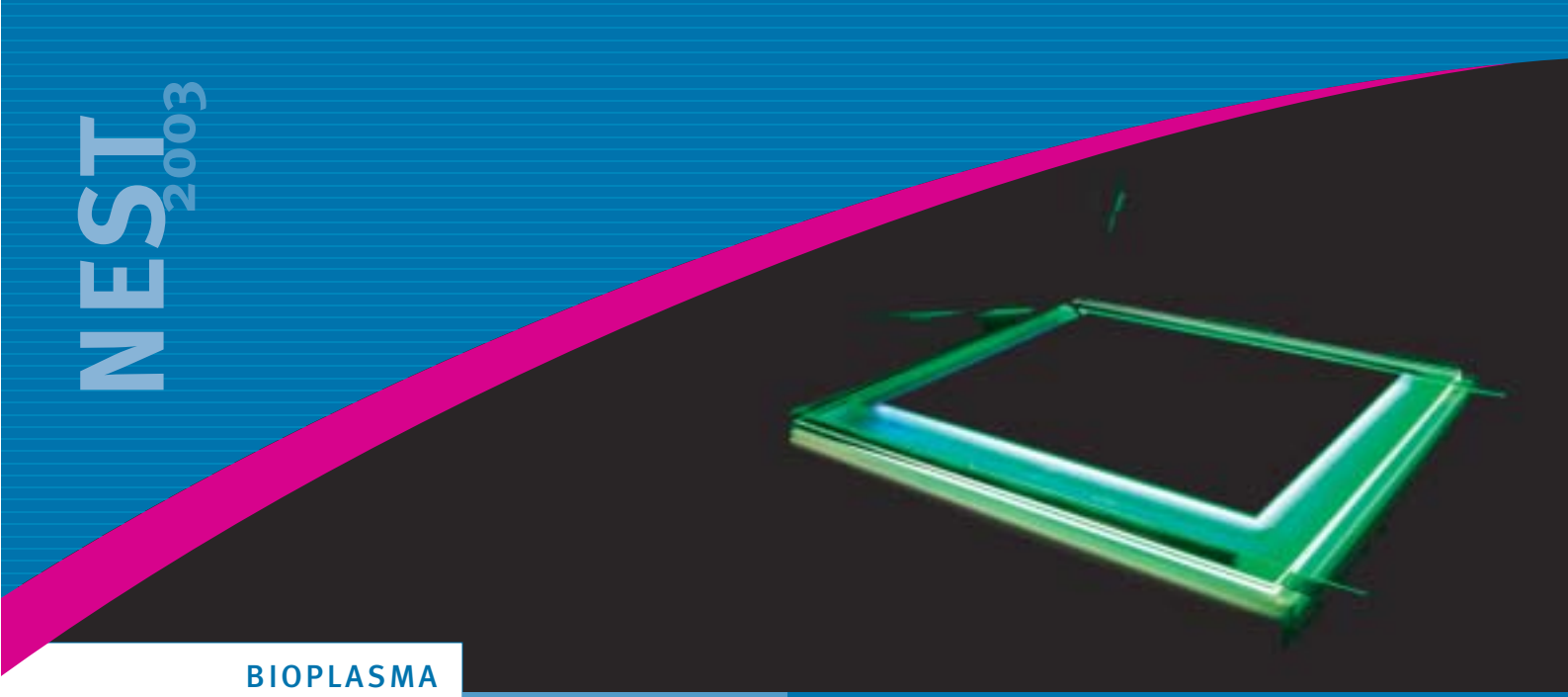
Beyond bioterrorism

If this project is successful, its societal impact could be great. Antibody-producing mucosa-colonising bacteria might be used against a wide variety of diseases, within or beyond the context of bioterrorism. A good target, for instance, might be rotavirus, which kills nearly a million people (mostly children in developing countries) each year. Administered anti-rotavirus antibodies, on the one hand, and selected lactobacillus strains, on the other, are known to confer some protection. Might antibody-producing lactobacilli work even better?

Antibody-producing, mucosa-colonising bacteria might be used against a wide variety of diseases, either within or beyond the context of bioterrorism.

This innovative approach might extend to pathogens affecting the mucosae of the lungs, mouth, or stomach. If suitable vagina-colonising GRAS bacteria are isolated, it might also apply to sexually transmitted diseases (even HIV). In both developed and developing countries, it could provide a cost-effective way to address major public health problems on a large scale.

SIXTH FRAMEWORK PROGRAMME



BIOPLASMA
NEST ADVENTURE

The project objective is to develop a one-step process, applicable on a large scale, for immobilising biomolecules on surfaces of practically any kind.

‘Biocoating’ surfaces with atmospheric plasmas

Biological molecules display remarkable functions that developers of new materials are eager to harness. A European consortium is exploring an original approach to coating the surface of almost any material with active biomolecules. The idea is to use cold atmospheric-pressure plasmas to deposit the biomolecules together with a thin polymer coating. Potential applications are wide-ranging, and the partners hope to obtain biocoatings optimised for specific uses within the next three years.

Plasmas are ionised gases that conduct electricity, like the matter present in the electric arc of a welder’s torch or inside a neon light. One well-established coating technology involves exposing a surface to a plasma to which monomers (polymer building blocks) have been added. The plasma induces formation of a polymer coating on the treated surface. BIOPLASMA is a NEST project aiming to take this approach into new territory.

The project objective is to develop a one-step process, applicable on a large scale, for immobilising biomolecules on surfaces of practically any kind. The idea is to add both monomers and biomolecules to a plasma so as to incorporate functional biomolecules into a thin polymer coating.

The low-pressure plasmas frequently employed in plasma polymerisation cannot be used here because they damage biomolecules. Instead, the BIOPLASMA partners will use cold (0-60°C), ambient-pressure plasma processing, a comparatively new technology offering milder surface-treatment conditions. Additional advantages include lower process costs, the ability to work in-line, and compatibility with practically any substrate. This innovative approach to surface bioengineering presents a major challenge: little is known about how such plasmas affect the structure and activity of biomolecules.

Feasibility and optimisation

The BIOPLASMA consortium counts four partners in four countries (Belgium, France, Germany, and Italy). Their aim is to establish the feasibility of the envisaged technology by producing active functional biocoatings. In doing so, they will strive to optimise the process and to determine its potential limitations. For this, they can count on a vast pool of expertise, ranging from atmospheric plasma technology and polymer science to molecular biology, bacteriology, enzymology, bio-catalysis, proteomics, and biophysics.

The project will require a prototype reactor to be built, and will involve both small-scale laboratory work and the use of large European-scale facilities. In parallel with extensive work devoted to optimising plasma conditions for polymerisation and biomolecule incorporation, research will

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BIOPLASMA
NEST ADVENTURE

If successful, the project should lead to spectacular inroads in the field of bio-mimetic surgical implants.

AT A GLANCE

Official title
Bio-engineering by atmospheric plasma treatment

Coordinator
Belgium: Vlaamse Instelling voor Technologisch Onderzoek

Partners
- *France: Université de Bretagne Occidentale*
- *Germany: Westfälische Wilhelms-Universität*
- *Italy: Università Politecnica delle Marche*

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Duration
36 months

Project Cost
€ 1 571 436

EU Funding
€ 1 160 000

Project reference
Contract No 509012 (NEST)

Web: http://www.cordis.lu/nest

focus on producing the biomolecules to be tested: enzymes of pathways leading to biotechnologically relevant products. Of particular interest will be enzymes from thermophilic ('heat-loving') organisms, expected to show higher stability under non-optimal conditions. If necessary, enzymes will be overproduced in recombinant bacteria.

At first, plasma processing and protein processing will be optimised separately. Then, after a mid-term feasibility assessment, these two aspects should be integrated. In the last year of the project, promising biocoatings will be optimised for specific applications.

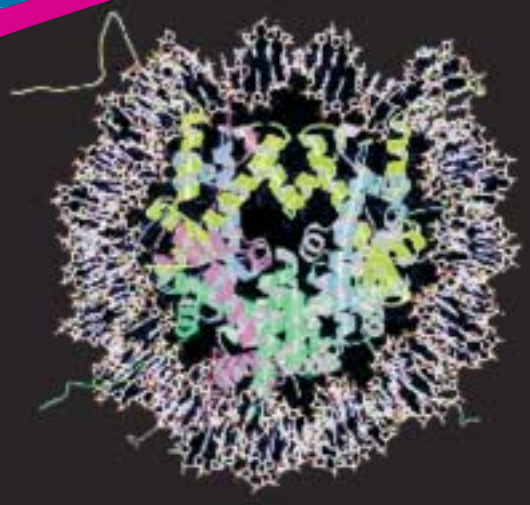
It might be possible, for instance, to create a 'lab-on-a-chip' bearing all the enzymes participating in a biosynthetic pathway.

Prospects

Existing methods for immobilising biomolecules on surfaces have drawbacks. Simple adsorption is quick and cheap, but the biomolecules are not stably immobilised. Other techniques require expensive substrates (e.g. gold) or linkers. Most involve a succession of steps, and this makes scaling-up difficult. The new technology developed in BIOPLASMA should avoid such problems.

If successful, the project should lead to applications in sectors as diverse as chemicals, medicine, environmental monitoring, food, high-tech materials. It might be possible, for instance, to create a 'lab-on-a-chip' bearing all the enzymes participating in a biosynthetic pathway. In addition to applications in bio-catalysis, plasma-polymerised biosurfaces might find their way into antimicrobial packaging materials, bio-mimetic surgical implants, scaffolds for growing functional tissues, surfaces for directing mineralisation or controlled drug release, biosensors for pollutant detection, diagnosis, or toxicity testing, 'intelligent' textiles transmitting biological signals to a processor, etc. And groundbreaking technologies like this also tend to spawn innovative applications that were not imaginable at the outset.

SIXTH FRAMEWORK PROGRAMME



CHIRALTEM
NEST ADVENTURE

Equipped with EMCD, a TEM could study the crystallography, morphology, chemistry and magnetic properties of a sample in one session.

Magnetic microscope puts electrons in a spin

Electron microscopes can study materials in unrivalled detail but, unlike competing x-ray methods, they cannot map magnetic fields. CHIRALTEM sets out to confirm a surprise discovery that an ordinary transmission electron microscope can be adapted to sense magnetic fields in a specimen. If successful, the project could open the way to mapping the magnetic structure of surfaces and thin layers at nanometre scales and could have an impact in nanotechnology, especially in the new field of 'spintronics'.

A multidisciplinary team from four countries is setting out to demonstrate a new technique for studying the detailed magnetic structure of materials. Since the 1930s, physicists have used the transmission electron microscope (TEM) to make much finer images of surfaces than is possible with light or even x-rays. Individual atoms can now be discerned as a matter of routine. But while the TEM has been developed into an extremely versatile tool, there are still some things that it cannot do.

One of these is to map the magnetic fields in a specimen. In this case, physicists use a different technique (known as XMCD) in which a polarised beam of x-rays is directed at the specimen and absorbed differently according to the direction of the magnetic field – a phenomenon known as dichroism. But the resolution is not as fine as a TEM and the source of x-rays – a synchrotron accelerator – is a large, rare and expensive piece of apparatus.

In principle, a TEM could sense magnetic fields if a polarised beam of electrons were available: that is, a beam in which all the electrons spin in the same direction. As this is not yet feasible, physicists assumed that a TEM could not be used to study the magnetic structure of a specimen.

Surprise discovery

Then, in 2003, Peter Schattschneider and Cécile Hébert at the Technical University of Vienna – now the CHIRALTEM project coordinators – discovered to everyone's surprise that dichroic effects should be observable in a TEM with an ordinary, unpolarised electron beam. The object of CHIRALTEM is to demonstrate this new effect experimentally – they call it EMCD – and find out how it could be used for investigating materials.

The first step, for the Vienna group, is to confirm that the dichroic effects can actually be seen and observed with a TEM using well-known magnetic materials. At the same time, Josef Zweck's group in Regensburg will investigate how to prepare specimens and control the magnetic field in the microscope, while Pavel Novak's team in Prague will develop computer simulations to support the experimental work. A group led by Hannes

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The project opens the way to the study of biological magnetic materials, such as those which give rise to the magnetic 'compass' sense in pigeons.

CHIRALTEM
NEST ADVENTURE

AT A GLANCE

Official title
Chiral dichroism in the transmission electron microscope

Coordinator
Austria: Institute for Solid State Physics, Vienna University of Technology

Partners
- *Germany: Institute for Magnetism and Magnetoelectronics, University of Regensburg*
- *Germany: Institute of Structure Physics, Dresden University*
- *Czech Republic: Institute of Physics, Academy of Sciences of the Czech Republic, Prague*
- *Italy: National Laboratory for Advanced Technologies and Nanoscience, Trieste*

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Duration
36 months

Project Cost
€ 890 000

EU Funding
€ 890 000

Project reference
Contract No 508971 (NEST)

Web: http://www.cordis.lu/nest

Lichte in Dresden will then find the optimum conditions for using the technique.

Finally, Elvio Carlino and his colleagues in Trieste will compare ECDM with the longer established XCMD to find out how the two approaches can complement each other. They also intend to promote contact between electron microscopists and synchrotron users, two disciplines which have historically had little to do with each other.

As well as reporting their findings at international conferences and in scientific journals, the project team will hold a workshop for users and manufacturers of TEMs, and later a joint interdisciplinary workshop with XCMD users to explore further collaboration.

EMCD is expected to be able to discern magnetic structures ten times smaller than the best current x-ray techniques.

First in the world?

EMCD is expected to be able to discern magnetic structures ten times smaller than the best current x-ray techniques. Where XCMD scans surfaces, a TEM probes volumes up to 100 nanometres thick, so EMCD is ideal for the study of thin magnetic films. Equipped with EMCD, a TEM could study the crystallography, morphology, chemistry and magnetic properties of a sample in one session. As far as the team is aware, no other research of this nature is being done anywhere in the world, though groups in the US are likely to start on it sooner or later.

If the project is successful – and success is by no means assured – it could lead to a whole new field of study. It will certainly have applications in nanotechnology and especially in the new field of spintronics – a technology that makes use of the magnetic field of electrons as well as their electric charge. It also opens the way to the study of biological magnetic materials, such as in those in certain bacteria or which give rise to the magnetic 'compass' sense in pigeons. European industry could benefit from developing equipment for the new technique.

The partners aim for a scientific proof of principle. The purpose is to establish an enabling technology. Exploration of applications of EMCD themselves, as that would require a much larger consortium, is left to a future project.

SIXTH FRAMEWORK PROGRAMME

Biofilms are associated with many industrial corrosion phenomena.

Sparks from bacteria can power the future

Electrochemically active biofilms, which can achieve a direct electrochemical connection when they form on a conductive material, may be the basis of a new power source. Biofilms of micro-organisms form naturally on solid surfaces. Until now, they have been seen as harmful, either to human health, or to industrial products. But recent research suggests they have properties which can be used to catalyse or control electrochemical reactions, and could lead to a wide range of new products and processes over the next decade.

Recent research has identified the phenomenon of electrochemically active biofilms (EABs). So far, however, these results have come mainly through chance. And while they promise wide-ranging new applications in fields such as bio-energy, bio-remediation, chemical/biological synthesis, bio-corrosion mitigation and biosensors, the science is still at an early stage. Pursuing this research will allow scientists to increase their understanding of biofilms, which form naturally on a wide range of surfaces.

A multidisciplinary team of researchers from France, Italy, Germany, Belgium and Portugal, has set out, in an EU-funded project, to test a wide range of micro-organisms and identify those which are electrochemically active. Rather than growing new genetically engineered micro-organisms, as other research teams are doing, this team will take advantage of natural biodiversity and test existing microbial fauna.

Over a period of two years, they will screen a range of media, such as aerobic and anaerobic sea waters. Their aim is to identify the micro-organisms which form EABs through observing their behaviour on different electrodes.

Do it yourself

The challenge then moves on to growing these EABs under laboratory conditions, trying to recreate the properties exhibited in their natural state. The ability to do this reliably is, of course, the first step in developing industrial applications for EABs. In the laboratory, the team will also attempt to optimise the performance of the biofilms.

Laboratory work will be devoted to increasing understanding of the mechanisms of EAB formation. For example, why only specific organisms appear to be electrically active, the media and conditions in which they are electrically active, and the process in which EABs form.

Expanding knowledge

The team brings together a strong range of expertise in electrochemistry, materials and chemical engineering and microbiology. They aim to build a large, consistent and extensive database of a range of EABs. This

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The occurrence of EABs could offer potential improvements in production cost-effectiveness in the mining industry, particularly for the extraction of precious metals.

EA-BIOFILMS
NEST ADVENTURE

AT A GLANCE

Official title
Electrochemical control of biofilm-forming micro-organisms: screening, identification, and design of new knowledge-based technologies

Coordinator
France: Laboratoire de Génie Chimique - CNRS

Partners
- *Belgium: Universiteit Gent*
- *France: Commissariat à l' Energie Atomique*
- *Germany: Universität Duisburg-Essen*
- *Italy: 1. Consiglio Nazionale delle Richerche, Istituto Scienze Marine; 2. Centro Elettrotecnico Sperimentale Italiano Giacinto Motta*
- *Portugal: Fundação FCT, Departamento de Química, faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa*

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Duration
36 months

Project Cost
€ 3 056 378

EU Funding
€ 1 940 000

Project reference
Contract N° 508866 (NEST)

Web: http://www.cordis.lu/nest

will represent a significant increase in knowledge of EABs – in particular establishing whether there is a single model or not. Furthermore, assessing the actual electron transfer rate in the electrical connections formed will be a major contribution to assessing the feasibility of linked technologies and applications.

Most micro-organisms growing in the natural environment form biofilms on solid surfaces, such as metals, plastics or ceramics. These are usually seen as producing adverse effects on human health, through infection, or on industrial products, through biodegradation or corrosion, for example. It is estimated that corrosion costs developed countries around 4% of GNP annually, although the underlying causes are not well understood. Improving knowledge of EABs should improve knowledge of the causes of corrosion and, therefore, our ability to prevent it. But harnessing EABs is about much more than correcting negative effects.

Establishing the means to harness electrochemically active biofilms will result in a wealth of new scientific and technological applications.

Powering the future

The EAB phenomenon is gaining great importance through the hope that it can bring a breakthrough in fuel-cell technology. Applications for EABs might include new synthesis routes in biotechnology and food production, new strategies for protecting materials, new biosensors, implanted power sources connected directly to metabolisms, and new therapeutic processes.

In short, if the early results can be reproduced widely, the application of EABs could represent a massive take-up of natural power from bacteria in a wide range of fields.

SIXTH FRAMEWORK PROGRAMME

ELCAT
NEST ADVENTURE

Could the greenhouse gas, carbon dioxide, be used as a raw material in the production of fuels and other useful hydrocarbons?

Electrocatalysing a sword into a ploughshare

In the presence of an electrocatalyst, carbon dioxide can be reduced to useful hydrocarbons. The reaction can take place at room temperature and atmospheric pressure but it is not productive and exploitation is further hampered by rapid deactivation of the catalyst. A consortium of research organisations will explore this reaction and hopes, thereby, to lay the foundations for the advancement of knowledge in the neglected but promising field of electrocatalysed gas-phase reactions.

The ELCAT project was born of an observation made by the coordinating partner of an electrocatalytic reaction carried out at room temperature and atmospheric pressure. With carbon dioxide confined inside carbon micropores, and electrons and protons allowed to flow to an active catalyst – noble-metal nanoclusters – gaseous carbon dioxide was reduced to a series of hydrocarbons and alcohols. The reaction products were remarkably similar, in fact, to those of the Fischer-Tropsch (FT) process in which synthetic gas is converted to a series of hydrocarbons (alkanes, alkenes and so on) and water.

The FT process requires high temperatures and pressures and gets its carbon from the carbon monoxide, not dioxide, in synthetic gas. The focus of a lot of interest as a potential source of fuels and raw materials, it is already used in some countries to produce a substitute for diesel. One of its drawbacks is the difficulty of controlling the distribution of its products – which hydrocarbons are produced and in what proportions.

A process yielding FT-like products in useful quantities from a reaction not requiring high temperatures and pressures would be highly prized. If it could reduce carbon dioxide, an abundant greenhouse gas, instead of carbon monoxide, it would have outstanding potential. But the electrocatalytic reaction as it stands cannot do these things; not yet, at least. Two difficulties prevent it and the ELCAT consortium's mission boils down essentially to reversing them: the catalyst is quickly deactivated and the reaction's productivity is poor.

Twin experimental configurations

Scarcely any research has been reported in the scientific literature on gas-phase electrocatalysis, so the consortium is aware that completely disposing of these difficulties inside three years may prove elusive. Even if it does, a secondary goal should lead to valuable information on the feasibility of controlling product distribution. Another should add to what is currently known about the advantages of confining metal nanoparticular catalysts in carbon nanotubes.

The team will work with two experimental configurations. Built around a proton conduction membrane in which protons are generated by catalytic oxidation of hydrogen on the opposite side from the carbon

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Generating hydrogen from water in a single step is one possible long-term outcome of the research led by the ELCAT project.

ELCAT
NEST ADVENTURE

AT A GLANCE

Official title
Electrocatalytic gas-phase conversion of CO_2 in confined catalysts

Coordinator
Italy: Dipartimento di Chimica Industriale ed Ingegneria dei Materiali, Università di Messina

Partners
- *France: Laboratoire des Matériaux, Surfaces et Procédés pour la Catalyse, Université Louis Pasteur*
- *Greece: Department of Chemical Engineering, University of Patras*
- *Germany: Fritz-Haber Institut der Max Planck Gesellschaft*

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Duration
36 months

Project Cost
€ 875 246

EU Funding
€ 875 246

Project reference
Contract No 2400 (NEST)

Web: http://www.cordis.lu/nest

dioxide, the first will be operated at temperatures of 50–150°C for good reaction productivity. The second configuration will be similar but have an oxygen-anion-conducting membrane instead. Catalysing the reaction in both configurations, metal nanoparticles stabilised within carbon nanotubes are expected to generate very high local pressures inside the nanotubes. This, the partners believe, is probably an essential ingredient in the production of the FT-like products already observed.

The partners, though only four in number, bring diverse but complementary expertise to the project. One takes on the task of synthesising and characterising the nanotubes; another, that of analysing and characterising the underlying reaction mechanism; and the remaining two, those of testing the reaction in one configuration each.

Because ELCAT is embarking upon exploratory research in a field that, until now, has barely been noticed, any successes the team enjoys have the potential to entice further researchers to join them and open it up further. Indeed, the partners have deliberately kept the consortium small in size and tight-knit, the better to build a base of knowledge quickly.

If carbon dioxide can be converted into useful fuels at a low temperature, the possibilities are enormous.

The longer-term outcomes, though naturally difficult to gauge with any confidence, could be considerable in several technological areas. Similarities between the first configuration and proton-exchange-membrane (PEM) fuel cells suggest the possibility of knock-on improvements in the electrodes of PEM fuel cells. Moreover, if knowledge gained from the second configuration turns out to be transferable to the related solid-oxide fuel cell, the result might be capable, further down the line, of generating hydrogen from water in a single step.

Longer-term promise, then, is clearly not restricted to the obvious potential for converting carbon dioxide, a greenhouse gas, into useful fuels and raw materials on a large scale, though this alone would be an extremely handsome reward. Also more niche applications can be considered: Mars atmosphere is mostly composed from CO_2 and one of the limitations for the exploration of Mars by humans is the necessity of producing on-site the fuel necessary for the back flight. Knowledge generated within ELCAT project may be used to develop novel devices which can use solar energy, CO_2 and H_2O to produce fuels.

SIXTH FRAMEWORK PROGRAMME

The first tests in the INA project will relate to the surface structure of glass, its composition and production methods.

Atom optics for non-destructive nanoscale surface microscopy

Using advances in nanotechnology, a European research team proposes to improve on an imaging technique they pioneered. A microscope will be built, suitable for surface studies down to 20 nm, and will be tested to study the topography of glass. Although the experiments are primarily for scientific interest, if successful they will prove very useful to industry. The instrument is likely to have a tremendous impact on science since it will open novel opportunities for study – such as fragile biological probes or metastable materials – since samples will not require pre-treatment and will remain undamaged during analysis.

The team of engineers and scientists working on the 'imaging with neutral atoms' (INA) project proposes to develop a scanning helium-atom microscope which will make non-destructive and non-invasive surface investigations at the nanoscale a possibility. Their first tests will be to relate the surface structure of glass to its composition and production methods. But if they are successful, their microscope will help researchers working with a wide range of materials.

Atom-optics improvements

In the scanning helium-atom microscope the beam, composed of low-energy uncharged helium atoms, is brought to a focus on the sample by an atom optical element. In previous experiments, signal intensity was limited by the focusing technique, which used transmission lenses. The same limits will not apply in the new microscope, in which silicon-wafer atom-focusing mirrors will be used. The larger apertures these permit will allow greater signal intensity and, thus, make scanning helium microscopy possible for the first time.

The ideal mirror

The first atom-focusing mirrors were pioneered by two INA partners and basically consist of a chemically-prepared silicon wafer sandwiched between two alumina discs and suspended above an electrode structure. Applying an electric potential between the wafer and the electrode controls the deflection of the mirror into an aperture on one of the discs.

The production of the mirror surface for the current project will be challenging, as the partners will have to develop the necessary technology themselves. But it will be important too. The team includes pioneers in the field of scanning atom microscopy as well as experts in the preparation of ultra-thin wafers and optical equipment. To achieve the resolution they are aiming for, namely 20 nm, they plan to make various improvements to the mirror at both the macroscopic and atomic levels. These

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With its increased resolution, it is expected that the scanning helium-atom microscope will have applications in the study of fragile biological samples, for example.

AT A GLANCE

Official title
Imaging with neutral atoms

Coordinator
Austria: Institute of Experimental Physics, Graz University of Technology

Partners
- *United Kingdom: Surface Physics Group, Cavendish Laboratory, Cambridge University*
- *Poland: 1. Institute of Electronics Materials Technology; 2. Institute of Applied Optics*
- *Spain: Surface Science Lab, Universidad Autónoma de Madrid*
- *France: Saint Gobain Recherche*

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Duration
36 months

Project Cost
€ 1 776 661

EU Funding
€ 1 396 313

Project reference
Contract No 509014 (NEST)

Web: http://www.cordis.lu/nest

include reducing the error in the angle at which the crystals are cut, thereby minimising their warp; improving polishing techniques to ensure uniform crystal thinness; increasing the reflectivity of the mirror; and optimising the electrode structure.

Glass-surface topography

To test the equipment, once it is operational at the nanoscale level, the researchers plan to study the surfaces of different types of melt glass to identify a characteristic 'signature' for each type of glass. Glass surfaces look very similar when coming out of the melt, and atomic-force microscopy, which is also used to study glass surfaces, only reveals small differences in topography over a wide range. However, it is expected that the scanning helium-atom microscope used in the diffraction mode will be sensitive to both the topography and the chemical composition of the glass surface. These tests of the microscope on glass will, nonetheless, prove useful in themselves, in the preparation of glass formulations, where such a method is currently unavailable.

Microscope applications

With its increased resolution, it is expected that the scanning helium-atom microscope will have applications both in scientific research and industry. For example, it would be useful in the study of fragile biological samples, in companies involved in surface coating and for quality control in the semiconductor industry. As it has the potential to appeal to a wide market, the team anticipates that the microscope will eventually be manufactured.

By increasing the resolution to allow observation at the nano-scale, it is expected that the scanning helium-atom microscope will have widespread applications in both research and industry.

SIXTH FRAMEWORK PROGRAMME

OPTICAL NOSE
NEST ADVENTURE

In recent years, the increasing maturity of sophisticated laser technologies has recommended them for trace-gas detection.

A breath of hope from molecular fingerprints

Diagnosis of many medical conditions may be possible through breath testing, but technological and scientific barriers are slowing progress towards this goal. OPTICAL NOSE intends to tackle them head-on through two complementary strands of investigation – one into advanced mid-infrared fibre-laser sources and sensitive spectroscopic detection methods, the other into the relationship between breath composition and the progression of colorectal cancer and chronic obstructive pulmonary disease.

Nitrogen, oxygen and carbon dioxide together make up virtually all of the air in any breath exhaled by a human. The remainder is a complex mixture of many gases. Researchers have already identified traces of more than 3 000 volatile organic compounds (VOCs) in human breath. Trace-gas composition can tell us a great deal about the particular human who exhaled the breath. However, the connections between specific trace gases and their causes in the body remain unclear, and few breath tests have been devised to exploit the diagnostic potential of the breath.

The OPTICAL NOSE team has set itself the task of tackling head-on the two main obstacles holding back progress. Their practical objective is to exploit new fibre-laser technology to create a fast, sensitive and versatile trace-gas analyser for early detection of selected diseases. The consortium unites the expertise of four research centres and one company, which together cover the broad field of theoretical and applied modern optics, with the expertise of two medical research centres working on the study of colorectal cancer and chronic obstructive pulmonary disease.

Laser spectroscopy matures

First among the obstacles is the catalogue of limitations of established diagnostic detection technologies. Gas chromatography (GC) is typical. It is expensive and insufficiently sensitive for ready quantification of the ultra-low concentrations of VOCs in the human breath. Therefore, accumulation is needed which results in delays of hours before analysis results are ready. It is also slow and it can analyse only one gas species at a time.

In recent years, the increasing maturity of sophisticated laser technologies has recommended them for trace-gas detection. The consortium hopes to realise a step change in their versatility, to measure all trace-gas species present in complex gas mixtures in a single operation. Their apparatus will need to measure light absorption by the gas mixture at tens of thousands of discrete wavelengths per second. Another big challenge is the wavelength range, which must cover the molecular fingerprint region, stretching from 2.5 to 10 microns. Between these limits, most important gas molecules possess dense series of

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OPTICAL NOSE
NEST ADVENTURE

The breath may be the key to convenient and early diagnosis of many medical conditions.

AT A GLANCE

Official title
The OPTICAL NOSE: An on-line, non-invasive and total-profiling instrument for trace gas sensing applications in medical sciences

Coordinator
The Netherlands: Department of Molecular and Laser Physics Faculty of Science, Mathematics and Informatics, Stichting Katholieke Universiteit Nijmegen

Partners
- *The Netherlands: Universiteit Twente*
- *The Netherlands: University Medical Center Utrecht*
- *United Kingdom: SIFAM Fibre Optics Limited*
- *Germany: Laser Zentrum Hannover e.V.*
- *Italy: European Laboratory For Non Linear Spectroscopy*

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Duration
36 months

Project Cost
€ 2 234 820

EU Funding
€ 1 850 140

Project reference
Contract No 2504 (NEST)

Web: http://www.cordis.lu/nest

strong absorption lines which reveal their chemical composition.

To achieve these aims, they will investigate optical parametric oscillators (OPO) – lasers based on non-linear optics – for generating microsecond pulses of rapidly tuneable wavelengths in the mid-infrared region. An OPO of this kind operating at around 3 microns has already been reported. The partners hope to improve on its kind by experimenting with tuneable ytterbium-, erbium- and thulium-doped silica-fibre lasers to pump the OPO. In this way, they expect to increase the duty cycle to an acceptable level and, in particular, to enable the signal laser to be tuned rapidly across the whole molecular fingerprint region.

New medical data

The second obstacle is the scant nature of our knowledge of the relationship between the breath trace-gas composition and its causes. The two medical-research partners are to collect data relating the progression in patients of colorectal cancer (CRC) and chronic obstructive pulmonary disease (COPD) to the composition of breath samples taken from them. They will measure disease progression with state-of-the-art clinical techniques, and breath samples with the best extant trace-gas analysis techniques.

Results from these studies are essential if the final configuration of the laser-spectroscopy apparatus is to be validated, and then optimised, for breath-test detection of CRC and COPD. They may also serve to accelerate the search for VOC signatures more discriminating and reliable than those beginning to emerge in the medical literature.

Screening by breath

Breath tests could, in time, become as ordinary and versatile in medical screening as blood tests are today.

If the team demonstrates a practicable optical nose, it is not too fanciful to suppose that breath tests could, in time, become as ordinary and versatile in medical screening as blood tests are today. But it would be a mistake to think that this exhausts the possibilities. Applications in numerous fields are easy to imagine – from measuring the effect foodstuffs have on the body, and monitoring industrial chemical plants, to improving security in public places through detection of explosives and drugs.

SIXTH FRAMEWORK PROGRAMME

Evidence suggests that PFCs accumulate in blood, bile and the liver and it is possible that they may bind to proteins in blood and tissue.

Assessing chemical toxicity for competitive advantage

Perfluorinated compounds (PFCs) are used in many consumer products today. These chemicals are highly stable, do not degrade in the environment and can accumulate in living organisms. To make a full risk assessment of the environmental impact of PFCs, accurate data on their physicochemical properties and new tools to assess the movement and distribution of PFCs are needed. PERFORCE brings together expert teams, including industry, to significantly boost our understanding of PFCs.

Perfluorinated compounds (PFCs) are chemicals that have gained increased scientific and socio-economic interest following their detection in organisms from remote regions – including the polar regions – and in human blood.

PFCs have numerous useful applications in consumer and other products. They can be found in textile, carpet and leather treatments (for water and dirt proofing), surfactants, polymerisation aids, fire-fighting foams and paper additives. However, the primary useful characteristic of PFCs – their stability – means that in the environment they do not readily decompose and are therefore defined as persistent chemicals.

Blood and bile

In organisms, evidence suggests that PFCs accumulate in blood, bile and the liver and it is possible that they may bind to proteins in blood and tissue. Some classes of PFC have been shown to cause cancer in rats. PFCs are, therefore, an emerging group of environmental contaminants with unique physicochemical and toxicological properties. But how they enter and are transported within the environment is not well known, mainly due to a lack of physicochemical property data and reliable detection methods.

Information on the prevalence of PFCs in Europe is scattered and incomplete. In fact few reliable data on their chemical properties are available in the open literature, and prediction of environmental concentrations is not possible. In particular, the few unique characteristics known prevent the modelling of their properties using existing estimation methods. Clearly this substantial lack of information on the hazardous potential and environmental distribution of PFCs is of concern to policy-makers, producers and consumers.

PERFORCE is bringing together European expertise to introduce and evaluate new chemical and biological techniques and tools to assess the distribution of PFCs in the European ecosystem. This will reveal how PFCs get into the environment, how they move within and between different environmental compartments (i.e. ground, water, sediment, etc.), and determine their key environmental properties.

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PERFORCE
NEST INSIGHT

By gaining new insights into environmental chemical mechanisms, in particular the source and routes for PFCs detected in remote areas, an ecologically sound chemical replacement policy can be developed.

AT A GLANCE

Official title
Perfluorinated organic compounds in the European environment

Coordinator
The Netherlands: University of Amsterdam

Partners
- *Norway: Norwegian Institute for Air Research, The Polar Environmental Center*
- *The Netherlands: Netherlands Institute for Fisheries Research*
- *Sweden: Institute for Applied Environmental Chemistry, Stockholm University*
- *Belgium: University of Antwerp*
- *Belgium: DuPont Coordination Centre CVA*

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Duration
24 months

Project Cost
€ 1 104 500

EU Funding
€ 790 000

Project reference
Contract No 508967 (NEST)

Web: http://www.cordis.lu/nest

Scientific leader

The project, led by the University of Amsterdam, brings together researchers from the Netherlands, Norway, Sweden and Belgium (including DuPont, a leading PFC manufacturer) and aims to establish Europe as an international scientific leader in environmental research and exposure assessment for PFCs. Work will be split between developing new chemical analytical methods, bioanalytical tools, physicochemical property and fate modelling, environmental modelling and validation of techniques. An important component of the project will be transfer of know-how from industry to the academic teams. The final exposure assessment will be based on both field data and modelling.

The project will also link with other international initiatives, especially in North America and OECD projects, to provide calibration and comparison/standardisation of techniques to give a global dimension to this global problem.

Competitive advantage

By gaining new insights into environmental chemical mechanisms, in particular the source and routes for PFCs detected in remote areas, and by understanding the behaviour and distribution of PFCs, an ecologically sound chemical replacement policy can be developed which could provide a competitive advantage for the European chemical industry.

An ecologically sound chemical replacement policy can be developed which could provide a competitive advantage for Europe.

The introduction of new validated chemical and biological techniques and tools to assess the occurrence and distribution of PFCs in the European ecosystem that the PERFORCE team will deliver should allow a reliable exposure assessment for PFCs to be made. Together with ongoing hazard assessment and toxicity testing data, this can give the European authorities a proper environmental risk assessment of these chemicals in the near future.

This will be essential information for strategic decision-making and for regulatory action on directing industrial production and sustainable future application of PFCs.

SIXTH FRAMEWORK PROGRAMME

PORGROW
NEST INSIGHT

Overweight hurts individuals, and society.

Leaner times ahead

Obesity in Europe is reaching epidemic proportions, but Europe's policy-makers need more information about what controls might be acceptable and effective. The PORGROW project will provide national and cross-national information to analyse the varying perceptions and judgements of key stakeholder groups in nine countries. This should contribute to identifying promising policy initiatives, and helping policy-makers, industry bodies, public health and medical groups to make informed strategic choices.

Obesity is an intractable problem, causing suffering and predisposition to other medical conditions for the individual, and medical and social costs to governments. Treatment of obesity could be tackled in a variety of ways, but far less has been done to establish the optimal strategy for its prevention. It is not even clear whether there is an optimal way, or whether regional, nutritional, traditional or other differences in diet or culture mean that approaches should vary in different countries.

The PORGROW project will remove these uncertainties by using an innovative methodology to define how decisions on preventing obesity could best be made. For example, foods which are currently over-consumed, like manufactured cakes and biscuits, could be made less attractive by reducing subsidies, or the prices of fruit and vegetables could be reduced by increasing subsidies. Information on the nutritional value of foods could be made more accessible and meaningful to consumers, or marketing of locally-produced fruit and vegetables could be encouraged. PORGROW will employ the expertise of project participants to collect views on these possible approaches in nine countries, representing a broad range of geographic and demographic types. For this reason, their inputs can be expected to reflect a wide range of dietary, cooking, and physical activity regimes.

Multi-criteria mapping

The methodology to be used – multi-criteria mapping, MCM – was developed at the University of Sussex as a way to compare policy options. In the obesity study, MCM will be used to interview representatives of 20 different key stakeholder groups in each participating country. The categories will be the same for each country, and will include food producers (such as farmers and manufacturers), doctors, nutritionists, teachers, food retailers, advertisers, public policy-makers, consumer and sports organisations, self-help groups and members of the research and public-policy communities.

Each interviewee will evaluate policy options for addressing obesity, including six core options and up to six more of their own choice. Up to 12 evaluative criteria are also to be chosen by the

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PORGROW
NEST INSIGHT

What would stop you eating this?

AT A GLANCE

Official title
Policy options for responding to the growing challenge from obesity: a cross-national comparative study

Coordinator
UK: University of Sussex

Partners
- *Cyprus: Research and Education Foundation of Child Health*
- *Finland: The UKK Institute for Health Promotion Research*
- *France: Institut de Recherche pour le Développement*
- *Greece: University of Crete*
- *Hungary: Semmelweis Medical School*
- *Italy: Institute of International Sociology*
- *Poland: Instytut Zywnosci I Zywienia*
- *Spain: University of Alicante*

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Duration
30 months

Project Cost
€ 855 586

EU Funding
€ 741 943

Project reference
Contract No 508913 (NEST)

Web: http://www.cordis.lu/nest

interviewees who will rank each policy option for each criterion. A mathematical formula allows each interviewee's appraisal to be calculated and displayed as a bar chart. The interviewees can then review the findings, and reconsider or include new options or criteria if they wish.

Putting it all together

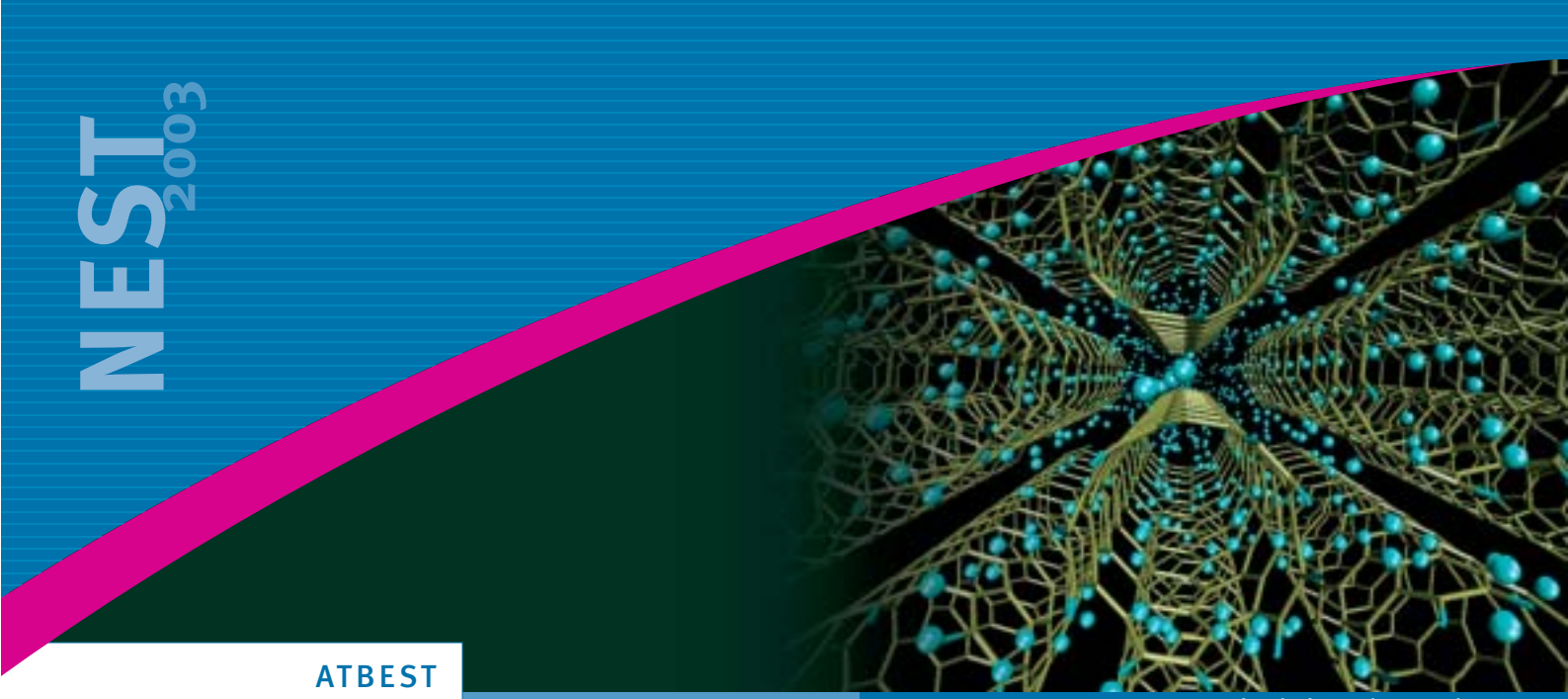
The data from all the stakeholder groups in each country will be reviewed by the national project teams, with the aim of finding out to what extent they can define a policy or collection of policies which might provide the most effective deterrent to obesity for that country. The national report for each country will draw out the main areas of agreement and disagreement in the perceptions of the different stakeholder groups, including both quantitative and qualitative responses.

PORGROW will define the policy or collection of policies which might provide the most effective deterrent to obesity.

The final stage is to compare the national findings. The cross-national comparison should provide a reliable account of the policy options that could be available, and of the views of the key groups on these options. It should, therefore, give policy-makers the best possible basis for taking a decision on which policies, and combinations of policies, will be most effective and acceptable to the various groups.

PORGROW is a NEST INSIGHT project, so its function is to investigate growing problems which threaten European society. It will meet this objective directly by identifying appropriate policies to limit the effects of obesity. As well as national policy-makers, the outcome will also be of great relevance to the development of future EU food policy and legislation. More indirectly, PORGROW's use of MCM will demonstrate how the approach can be used on other complex multi-factorial problems in the future. The approach may be applied to many other situations where some of the factors are uncertain, thereby enabling policy-making to become more flexible and effective.

SIXTH FRAMEWORK PROGRAMME



ATBEST
NEST SUPPORT

Random hydrogen in nanotubes.

Managing innovative science and technology, where uncertainty in both the outcome of research and the potential benefits are great, is a difficult task. ATBEST will develop novel assessment tools for interdisciplinary research with high societal and/or technical uncertainty, to help manage these tasks. The tools will be validated by practitioners working in new and emerging, potentially breakthrough fields, such as fuell cells or nanotechnology. If successful, the 'tool kit' will be a valuable asset for actors, ranging from public laboratories to private R&D, and high-level support programmes such as NEST.

Managing new and emerging science and technology

NEST supports unconventional and visionary research with the potential to open new fields for European science and technology. In such research areas, regular approaches to assessing research value and managing development may not be suitable. Current 'best practice' guidelines cannot be reliably used to measure the new paradigms and knowledge generated by ground-breaking research that, by its very nature, supplants existing ideas. NEST's SUPPORT actions provide the space for focusing on conceptual and practical questions associated specifically with NEST. ATBEST (Assessment Tools for Breakthrough and Emerging Science and Technology) is one project funded as NEST SUPPORT action that aims to develop a new process approach, with corresponding tools, for the assessment of new and emerging science and technology.

Richness

The start point for ATBEST is the recognition that emerging and potentially breakthrough areas of science and technology are characterised by a 'richness' in terms of discoveries to be made, and possibilities for their exploitation. Exploitation implies that only some, out of a multitude of possible linkages with actual use and uptake, will be pursued and realised. This will result in a push towards specific development, in contrast to the emphasis in pure research on openness and variety. It is important to take both aspects into account, because often studies of innovation (and policy-makers and managers) tend to focus only on specific developments and their outcomes.

A new process approach

The combination of great uncertainty and great potential requires assessment of processes, including search, articulation and interactive learning. Retrospective case studies on fundamental research have shown the 'knocks' and setbacks that can occur during the research process. Complementary technologies, secondary

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The tools will be validated by practitioners working in new and emerging, potentially breakthrough fields, such as fuell cells. © MAN

ATBEST
NEST SUPPORT

AT A GLANCE

Official title
Assessment tools for breakthrough and emerging science and technology

Coordinator
The Netherlands: University of Twente

Partners
- *France: Association pour la Recherche et le Développement des Méthodes et Processus Industriels*
- *United Kingdom: University of Edinburgh*

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Duration
12 months

Project Cost
€ 269 708

EU Funding
€ 196 360

Project reference
Contract No 508929 (NEST)

Web: http://www.cordis.lu/nest

assets, and social and cultural changes are vitally important to success. 'Picking the winners', as an approach applying selection criteria for the short-term evaluation of R&D performance, effectively restricts the many possibilities the potentially breakthrough science or technology offers. As it is impossible to definitively identify and assess possible 'breakthrough' scientific developments at an early stage, there is a need to focus on the process of development itself and the quality assurance of that process. Essentially the ATBEST assessment tools will use the tension between exploration (research) and exploitation (application) by asking how this tension is handled productively. If it is handled well then the chance of an emerging science and technology actually delivering on its promises will be high.

> There is a need to focus on the process of development itself and the quality assurance of that process.

ATBEST deliverables

In a recent report, ATBEST has consolidated the insights and experiences in the literature. The researchers are currently undertaking case studies in order to explore the dynamics of scientific and technological change, especially in areas of high technical risk and interdisciplinary research like nanotechnology, biotechnology, and fuel cells and the hydrogen economy. In such areas, all sorts of assessments occur continually, and the project team will identify those which can be used to develop further into generally usable tools and approaches.

From the portfolio of tools and approaches that will be produced, two will be selected for further development and a test in a workshop with practitioners (active scientists as well as managers and staff of science organisations). They will express their reaction to the approaches and tools as experts, with experiences and insights that can contribute to the project, but they will also be subjects because the ATBEST team will observe and document how they handle the two tools/approaches they are asked to work with. Among the participants will be researchers who have actively participated in NEST activities.

SIXTH FRAMEWORK PROGRAMME

NEST-IDEA faces the challenging prospect of rooting out ideas with great potentials.

A great idea for great ideas

A support action under the NEST initiative, NEST-IDEA will explore exciting new potential research possibilities. The aim is to raise awareness within the scientific community of unconventional research approaches, and of the rewards from sharing new concepts in emerging science and technology areas. The project will encourage the development of future NEST projects by pioneering research groups. Pinpointing the newest trends in research will stimulate and focus research policy in Europe.

All over Europe, many individual research workers and groups have ideas and theories which, if developed, could have an important bearing on the future of science, technology or society, but remain unknown. This may be because of lack of time, lack of funding, not having access to the right supporting expertise, or lack of insight into their possible application or value in the future.

NEST-IDEA has the challenging prospect of rooting out ideas with great potential. Its role in the NEST initiative is to identify the sources of such ideas, to facilitate their exchange with other relevant parties, and hopefully to stimulate the development of new NEST projects for the future. The participants in NEST-IDEA are all active in research policy and have long experience of EU-funded transnational projects. Project partners represent Germany, France, Spain, Poland and two countries associated to the EU's research programme – Switzerland and Israel.

Take your partners

One of the first steps will be to map the very best centres of scientific research in Europe, including small research groups, and particularly those in emerging subject areas. NEST-IDEA partners will work with national research agencies to determine which research groups could be future NEST participants. Working on both regional and national levels, the most promising ideas for future NEST projects can be defined.

Potential future NEST participants and other stakeholders will be invited to take part in information days, workshops and other meetings, ensuring their active participation from the beginning in new projects. These fora, and advanced internet tools, will be used for finding partners, establishing groupings, and for the exchange of best practices. A new NEST website will house a database of collected project ideas and details of

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One of the steps will be to map the very best centres of scientific research in Europe.

NEST-IDEA
NEST SUPPORT

AT A GLANCE

Official title
NEST – Information on development of emerging activities

Coordinator
Germany: EC Bureau of the German Ministry of Education and Research

Partners
- *France: National Institute for Agricultural Research of Ministries of Research and New Technologies*
- *Israel: Israel Europe R&D Directorate for FP6*
- *Poland: Institute of Fundamental Technological Research of Polish Academy of Sciences*
- *Spain: Conference of the Rectors of Spanish Universities*
- *Switzerland: Swiss Information Network on European Research*

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Duration
24 months

Project Cost
€ 335 494

EU Funding
€ 244 840

Project reference
Contract No 508966 (NEST)

Web: http://www.cordis.lu/nest

organisations active in research or funding, while researchers will receive assurance on the protection of their intellectual property. An invited group of researchers active in the dynamics of scientific change and management of interdisciplinary research (from the Julich Research Centre (Germany), the Israel Science Foundation, and the Helsinki School of Economics) will be consulted on the likely impact of the research ideas coming forward.

Looking for projects

NEST-IDEA will search for future ADVENTURE projects (for innovative, unconventional research with high potential impact) and INSIGHT projects (investigating the risks and opportunities for society presented by new sciences and technologies). Early warning of new impending problems to society (e.g. drug resistance, epidemics, or environmental change) is essential, and INSIGHT is a mechanism by which Europe can best prepare for them.

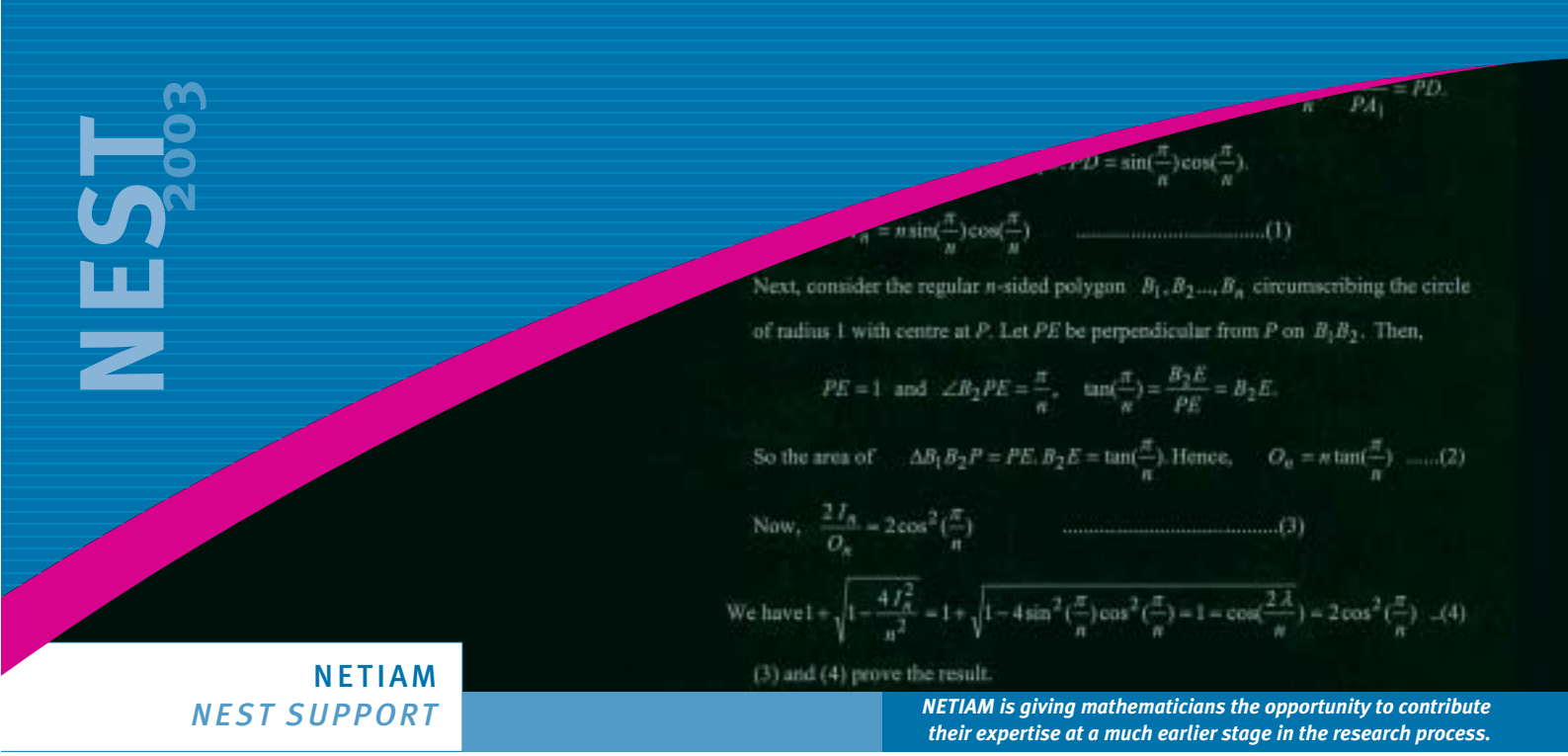
NEST-IDEA will root out ideas with great potential for innovative, unconventional studies.

The NEST-IDEA project will also invite its expert group to analyse the newest trends in world sciences. This intelligence will be supplemented by literature studies and monitoring of current conferences, which will give valuable pointers to present and future research emphasis.

The most promising ideas developed in NEST-IDEA initiative will also contribute to the formation of the third main type of NEST activity: PATHFINDER projects – strongly interdisciplinary approaches to the research areas which are emerging as having a truly fundamental importance and urgency for Europe (e.g. complex systems).

The results of NEST-IDEA, assessing the response of the scientific community to the NEST initiative, will help the European Commission in formulating future calls for NEST proposals. These proposals will be the source of the next generation of visionary science and technology projects in Europe.

SIXTH FRAMEWORK PROGRAMME



NETIAM
NEST SUPPORT

NETIAM is giving mathematicians the opportunity to contribute their expertise at a much earlier stage in the research process.

The NETIAM project is developing mathematics as a tool to integrate the approaches of science from many disciplines. New theoretical and computing techniques, and collaborative formulation of unexplored research challenges, enable maths to play a vital part in the research process much earlier than previously. The project will link multidisciplinary teams on four very complex problems of sociology, economics, manufacturing and natural sciences. The new common mathematical approaches derived should apply to many other issues, and generate new ADVENTURE and PATHFINDER projects.

Maths is the common denominator

Until now, mathematics has mainly been used for analysis, and for devising quantitative system models. Now the NETIAM project under NEST is giving mathematicians the opportunity to contribute their expertise at a much earlier stage in the research process. Working in each of four complex research areas, mathematical theories of multiscale phenomena, complexity, risk and uncertainty will be used to tackle four broad, complex themes. It is expected that broader principles will then emerge for building maths approaches more generally into the fundamental framework of research initiatives. NETIAM is a NEST support action, so it should contribute to the development of other future NEST projects.

Four key themes

NETIAM has five participating organisations, from five EU Member States. They will hold thematic workshops on the following areas:

- Modelling criminality in the social environment
- Challenges in modelling the business environment
- Challenges in visualisation and simulation for virtual materials analysis and design
- Complexity at the molecular level.

The themes have been identified by the partners as showing particular emerging opportunities for novel mathematics. They provide an opportunity to demonstrate how mathematics provides a common language with which to approach interdisciplinary research. The criminality study will explore the construction of models of collective behaviour, and develop tools for understanding and predicting large-volume crime and organised crime, ultimately working towards control methods. Maths in the business environment means advanced modelling for financial risk management – vital for future economic competitiveness. Developments here may lead to future NEST PATHFINDER initiatives.

Virtual materials analysis and design have recently been opened up by advances in 3D-imaging, computer speed and the sheer size of available memory. They have endless applications in industry, based

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Modelling criminality in the social environment is just one theme of the workshops that will be held by the NETIAM project.

NETIAM
NEST SUPPORT

AT A GLANCE

Official title
New and emerging themes in industrial and applied mathematics

Coordinator
United Kingdom: Smith Institute

Partners
- *Germany: Fraunhofer-Institut für Techno- und Wirtschaftsmathematik*
- *Italy: Università degli Studi di Firenze*
- *Latvia: Ventspils University College*
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18 months

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Web: http://www.cordis.lu/nest

on new applications in stochastic and differential geometry, theory and numerics of partial differential equations, optimisation and control theory. These advances could lead to improved product quality, significant reductions in manufacturing and testing costs, and production lead times, and better use of energy and raw materials. The fourth area concerns a broad range of research subjects in biological and materials sciences where mathematical modelling is required. Molecular-level events are responsible for key functions like the targeting of drugs towards particular body tissues, so the workshop will address the geometry of such events, in terms of quantum mechanical calculations and new ways to model atomic and gene activity.

This is an opportunity to show how mathematics provides a common language with which to approach interdisciplinary research.

Ideas beget ideas

During the planning, each theme will be considered in relation to the others, to facilitate cross-fertilisation of ideas and determine where similar mathematical challenges arise in different contexts. This open, multidisciplinary approach should enable generation of potential NEST ADVENTURE projects.

Up to 20 experts, including mathematicians, other researchers, and end-users in industry, business and government will be invited to each thematic workshop. The operation will be facilitated by staff experienced in brainstorming with multidisciplinary groups. Their aim will be to ensure a balance between strategy and detail, and a mix of scientific 'push' and application 'pull'. The workshop reports on the new opportunities for mathematical research in each area will be disseminated widely to raise awareness of NEST, including through the project partners' existing networks, including ECMI (the European Consortium for Mathematics in Industry), MACSInet (Mathematics, Computing and Simulation for Industry), the Fraunhofer Gesellschaft in Germany, and the UK's Faraday Partnership for Industrial Mathematics. Finally a plenary workshop, arranged by the project coordinator, will then pull together the outcomes of the four work areas, and intends to integrate and develop further their ideas, hopefully to generate future PATHFINDER initiatives.

SIXTH FRAMEWORK PROGRAMME

KI-NA-21215-EN-C

This folder contains fact sheets on NEST-funded projects following the first NEST call for proposals in 2003.

For further information, please consult the NEST website:
http://www.cordis.lu/nest/

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