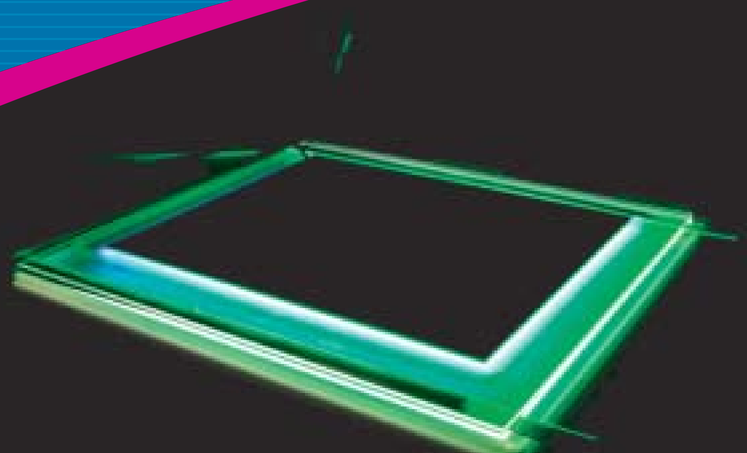
NEST 2003

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

→

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*

Further information
Dr Sabine Paulussen
Vlaamse Instelling voor Technologisch Onderzoek - Materials Technology,
Mol, Belgium
Fax: +32 (0)14 321 186
E-mail: sabine.paulussen@vito.be

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.

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.

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

SIXTH FRAMEWORK PROGRAMME