

IN BRIEF

4

ANIMAL-FREE MODEL FOR RHEUMATOID ARTHRITIS RESEARCH

A new model has been developed for rheumatoid arthritis research that does not rely on animal experiments.

Rheumatoid arthritis is a very prevalent, highly debilitating disease that causes pain and inflammation of the joints in sufferers. It is not exactly clear how the disease spreads through the body, but we do know that certain cells are involved in its inception and progression. A new research model has been developed for studying the processes that cause rheumatoid arthritis at the cell level. It can also be used to test the effects of new drugs without using animals. That will cut back greatly on the number of animal experiments needed for follow-up trials. The newly developed animal-free model combines two relevant cell types, which allows researchers to also study more complex pathological processes.

The model was developed by the Leiden University Medical Centre (LUMC) and TNO. In fact, earlier this year, the *Stichting Stimuleringsfonds Alternatieven voor Proefdieren*, a foundation that promotes alternatives to animal experimentation, awarded its Willy van Heumen prize to Prof. Tom Huizinga of LUMC for his work. The partnership between LUMC and TNO has already yielded a great deal of expertise on the cellular processes at work in joint disease, with LUMC performing the basic research and TNO implementing the techniques thus developed in its research for the pharmaceutical industry. LUMC and TNO have decided to intensify this partnership and shift the brunt of their research to osteoarthritis (degenerative joint disease). Here, too, models will be developed that simulate the relevant pathological processes, with the animal studies being reduced or refined. The prize-winning research was supported in part by ZonMw (Netherlands Organisation for Health Research and Development).

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BREAKTHROUGH IN FLEXIBLE LIGHTING

Holst Centre, Philips Research and Agfa Materials have made a breakthrough in flexible OLED (Organic LED) lighting.

Light-emitting wallpaper, textile videoscreens and flexible solar cells will become real applications once organic (or plastic) electronics make a breakthrough in the market. And if OLEDs are to penetrate the lighting market, then they will have to be produced cheaply and in bulk. An example is 'roll-to-roll' in the way newspapers are printed, with a film rolling through a print machine that can apply layers to it. The shape, materials and sequence of the layers determine the end product.

The Eindhoven-based Holst Centre, a TNO-IMEC initiative, has developed an OLED that can be produced on such a 'roll-to-roll' machine. This is a pliant light-emitting tile measuring 12 x 12 centimetres (*photo*). An electrical, highly conductive Agfa Materials plastic replaces two

existing layers in this tile. One layer less makes production cheaper. Moreover, the researchers have been able to print parts of the OLED using inkjet technology rather than the more complicated and more expensive (lithographic) illumination process used to date for this purpose.

Holst Centre is now collaborating with industrial research partners, including Agfa Materials and Philips, to get these processes applied on 'roll-to-roll' machines so as to enable OLED rolls of 250 metres or longer to be used. The participating companies will have to decide when to acquaint the market with this but the researchers reckon that 'light-emitting wallpaper' will be feasible within five years or so.

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TNO MODEL CALCULATES ACIDIFICATION OF GERMAN ECOSYSTEM

TNO has developed a model for the German Umweltbundesamt (UBA) that makes it easier to establish emission reduction targets for acidifying substances.

In order to protect vulnerable ecosystems, all European countries have to reduce the emission of acidifying substances like SO_x , NO_x , and NH_3 (ammonia) and comply with the emission reduction targets set by the European Union. These airborne substances, mainly emanating from traffic, industry and agriculture, can cause damage if they arrive at the soil (known as dry and wet deposition). Since dry deposition especially is difficult to measure, it is tricky to establish the source and extent of the air pollution.

The TNO LOTOS-EUROS model lays a relationship between air quality and the origin and deposition of acidifying substances. In the MAPESI ('Modelling of Air Pollutants and

Ecosystems Impact') project being carried out by TNO for the UBA key issues are 'how much acidification can a soil bear?', 'in which areas are the norms for concentrations of acidifying substances being exceeded?' and 'which sectors have to reduce their emissions?'.
The model that has been developed enables the deposition of acidifying substances to be calculated according to the concentration of the airborne substance, the source of the substance to be identified and the most effective policy measures to reduce the emission to be ascertained.

The model uses field measurements combined with data about the sources, wind directions and speeds, distribution models and chemical transformations in the air. TNO's experience in the field of dry deposition goes back thirty years

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SMART DRIVING WITH ICT

After three years of research, smart driving was given a practical demonstration earlier this year.

Technology can help promote safe, clean and efficient car driving – by taking care of vehicle-to-vehicle communication and by making realtime connections possible with the surrounding infrastructure. Two pan-European projects geared to cooperative traffic systems, as they are known, CVIS and SAFESPOT are being sponsored by the European Union (to the tune of 40 million euros) and coordinated by ERTICO-ITS Europe and Centro Ricerche FIAT, Italy. Both projects got under way in 2006 and are expected to be completed in 2010.

SAFESPOT focuses mainly on safety. Pedestrians, cyclists, car drivers – wherever a potential hazard lies, this is signalled and may be passed on along with advice, where appropriate, on choice of lane or route.

CVIS, or 'Cooperative Vehicle-Infrastructure Systems', is a project aimed at making communication between vehicles and their surrounding infrastructure possible as well as, equally importantly, creating a single architecture and an open concept for cooperative systems. In addition to the technological possibilities of SAFESPOT and CVIS, user acceptance, openness and interoperability are key aspects of these projects.

As one of the partners in these projects, TNO is contributing a breadth of expertise. Together with Logica, TNO is test site leader in the Netherlands for SAFESPOT and CVIS technologies and applications.

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CO₂ CAPTURE: STRATEGIC COLLABORATION WITH SIEMENS

Siemens AG and TNO will be collaborating strategically to develop CO₂ capture technology based on amino-acid salts.

Technologies for the capture of carbon dioxide from power stations fired by fossil fuels is taking on increasing significance. The kind of high-tech knowledge of CO₂ capture using amino-acid salts possessed by both Siemens and TNO is evident in a pilot installation currently being built by Siemens for CO₂ capture in the Frankfurt Hoechst industry park and in the pilot installation that has been operating since April 2008 at the E.ON Benelux site in Rotterdam. The latter makes use of the knowledge that TNO has been accumulating on CO₂ capture and storage since the previous decade, thereby making TNO one of the first players to be involved in pilot projects that embrace second-generation CO₂ capture solutions.

The aim of the collaboration between Siemens and TNO is to accelerate the time-to-market of this highly promising second-generation technology. TNO will use its expertise in the area of amino-acid salts to help Siemens construct a large-scale demonstration installation in 2014. This collaboration was cemented by an agreement signed by the two parties at the end of June this year.

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IN BRIEF

22

ENGINEERING THE BERLIN WHEEL

TNO advised the designers of the Ferris wheel that will start operating in Berlin by the end of 2010.

The Berlin Wheel is a Ferris wheel with a height of 185 m. The 36 capsules that run around the wheel's rim can each hold up to 40 people. The wheel is a circular framework structure with pre-tensioned spokes and it is currently being built on the Hertzallee in the German capital.

The engineering company Korndörffer Contracting International asked TNO to be involved in various facets of the wheel's design. This gave TNO the opportunity to contribute its expertise in the field of structural mechanics, wind load, steel structures, dynamics, reliability analysis and human comfort. Data on the wind load were supplied for the structural calculations, recommendations were made concerning the target level of safety in the reliability analysis; a dynamic analysis was performed to incorporate vibration behaviour of the wheel into the structural design; the comfort level of the passengers was reviewed and advice was given on the shock absorbers needed to limit the dynamic behaviour of the structure.

At the end of the 1990s TNO, as advisor to constructor Hollandia BV, was also involved in the construction of the London Eye in Britain's capital. TNO has also advised on the structural design of the Dubai Wheel.

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Photo: Korndörffer Contracting International



Photo: Walter van Dijk / TNO

REALISTIC SCENARIOS FOR TODAY'S THREAT

The threat to society is coming from a different angle. But how can we identify it?

Threat analysis of a chemical or biological attack in the past focused predominantly on a major military offensive by the former Soviet Union. The current threat – mainly from terrorist cells – differs from the past. This change can be characterised as a shift in the large-scale use of classical weapons to the use of a broader and less defined spectrum of agents that pose a threat to health, ranging from industrial and agricultural chemicals to agents of a natural origin.

The threat is becoming increasingly more difficult to ascertain given the range of possible weapons and changing military operations, particularly in urban environments. A new and more realistic perception of the threat is necessary to advise both military and emergency service personnel on the required level of protection. Currently, there is no clear, accepted way of obtaining a realistic perception of the threat.

TNO is therefore developing a method whereby a more realistic threat spectrum can be defined, one that is better capable of dealing with current and future situations. The method describes the different steps that lead

to a CBRN (chemical, biological, radioactive and nuclear) attack. It starts with defining a number of actors and their specific characteristics, such as the means at their disposal to acquire CBRN resources and their motivation to carry out attacks. This enables us to derive the capabilities of certain actors to acquire CBRN agents, their dispersal devices and to identify the motivation of the actors to attack certain targets.

The method thus generates relevant scenarios for a particular target or category of targets. In addition, the effectiveness of the preventive and mitigating measures can be reviewed by analysing the scenarios using different models. The results can help to identify gaps in the defence and future research needs as well as to provide advice on any preventive or mitigating measures that can be applied to increase the security.

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4,000 METRES HIGH UP IN HELMOND, THE NETHERLANDS

TNO's new vehicle test facility, which is now operational, offers a wide range of temperatures and air pressures.

Intensive practical tests in very diverse, extreme conditions form an inextricable part of new truck and commercial car development. Such tests are becoming increasingly important because vehicles have to keep their exhaust emissions within permissible limits in all kinds of altitude and temperature conditions. In the past just demonstrating that a vehicle could comply with emission requirements at sea level and at around 25 °C was enough, but in the future manufacturers will certainly have to guarantee that the emission requirements can be fulfilled in more realistic altitude and temperature conditions during the vehicle's lifetime.

The low air pressure that prevails at higher altitudes and very high or even very low ambient temperatures can affect the operation of the engine and exhaust gas after-treatment systems, like catalytic converters and diesel particulate filters, and thus exhaust gas emissions. By carrying out a significant portion of the required tests in a seasonally independent laboratory environment, development time can be reduced significantly. Since the tests are both repeatable and reproducible, not only is efficiency boosted but also quality of data acquisition compared with road measurements.

The test facility is also suitable for the development and refinement of the engine and exhaust gas after-treatment systems or to investigate the comfort afforded by a vehicle's interior climate.

In the new test area at TNO in Helmond vehicles can be tested at temperatures between -45 and +55 °C and at air pressures such as those at 4,000 metres above sea level. Wind speeds of up to 120 km/h can also be generated. These facilities make it possible for a large number of different tests to be performed very efficiently. The new facility is due to go into production from this September, the month of publication.

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POST-MORTEM FATE OF CHEMICAL WARFARE AGENTS INVESTIGATED

What happens to the chemical warfare agents of contaminated fatalities after an attack?

There is a conceivable risk to others if the chemicals in the bodies of victims contaminated in an attack with chemical warfare agents evaporate or if physical contact is made with the bodies. Little is yet known about the *post-mortem fate* of the chemical warfare agents that are absorbed by the body through breathing or via the skin, or remain on the skin itself. Contamination of personal property on the body, like clothing and mobile phones, could also form a risk.

TNO and the Netherlands Forensic Institute have been assigned by the US Defense Threat Reduction Agency (DTRA) to fill this knowledge gap and also develop a computer model that enables a better assessment of the respective risks. The study, which has a budget of more than half a million euros, will last for two years.

DTRA had called on TNO's expertise in earlier studies that concerned the *fate* of botulinum toxin in the body and the development of new antitoxins for nerve agent poisoning.

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As an independent organisation, TNO turns knowledge into practical applications and so contributes to the innovative capacity of business, both at home and abroad, as well as social and international organisations.

TNO has a broad package of products and services, from advising on policy, products and services and performing contract research to the testing and evaluation of products and systems and certification according to international standards. In addition, TNO focuses on future knowledge issues through the TNO Co-financing programme, with co-financing through business that helps establish the direction of this knowledge development. Finally, TNO provides licences to some 700 inventions in its patents portfolio.

The expertise of nearly 4,300 employees has been brought under five core areas:

- TNO Quality of Life
- TNO Defence, Security and Safety
- TNO Science and Industry
- TNO Built Environment and Geosciences
- TNO Information and Communication Technology

The TNO Companies holding company brings innovations to the market via its specially founded subsidiary companies.

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