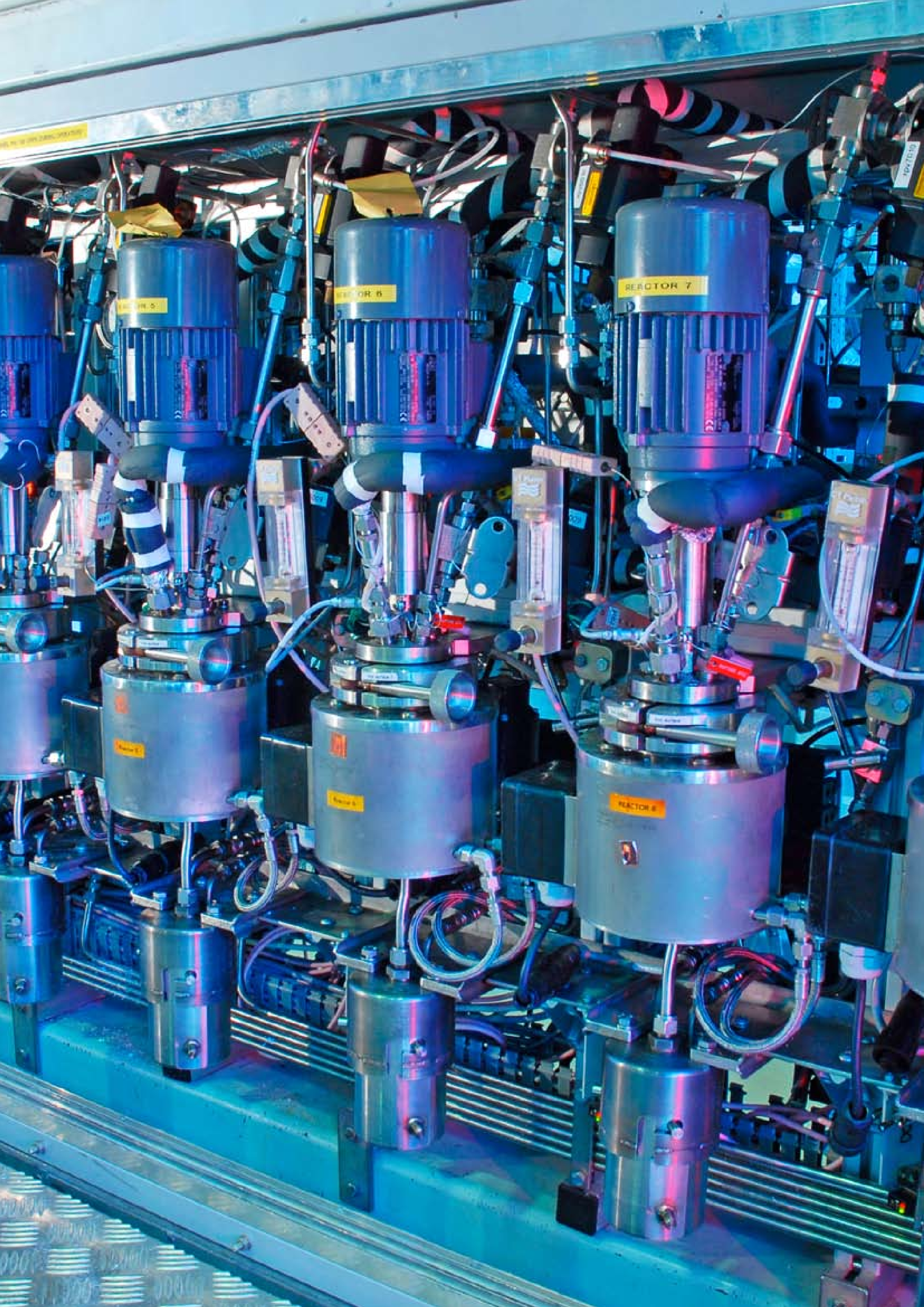
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Contents

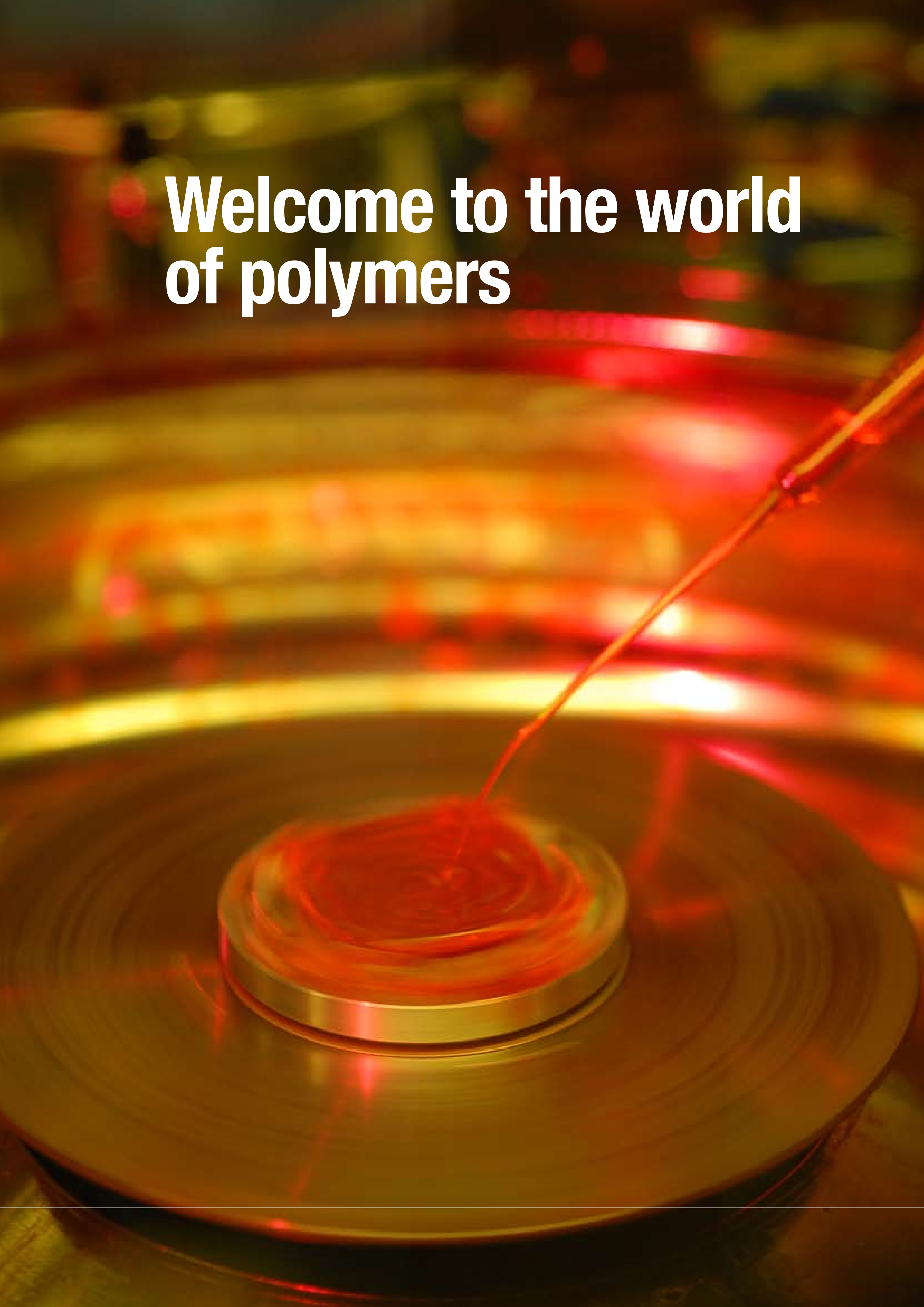
Dr. Gert Berendsen
Senior Director, Performance Plastics & Chemicals R&D, Dow Benelux B.V.
“DPI is one of the few programmes outside the USA that we as Dow give our attention and support to. It delivers something that is well-connected with our internal programmes.”

Dr. Henk Maatman
Manager, Teijin-Twaron Research Institute
“The DPI concept, including the Corporate Research programme, offers companies the opportunity to cover new developments in polymer science and technology with a breadth of scope to date almost unachievable by a single company.”

Prof. Karel Luyben
Dean of the faculty of Applied Sciences, Delft University of Technology
“DPI has in the past been instrumental in keeping academic chairs in polymer science and technology at Delft University of Technology. Thanks in part to DPI, polymer research and education in Delft is now very much alive and growing again.”

Prof. Jos Put
Vice President, Corporate Technology, DSM
“DPI offers our company the opportunity to attract competent recruits who are well-educated in polymer science. This is very valuable within our own company, but also improves our competitive position in technical discussions with our customers.”

Welcome to the world of polymers

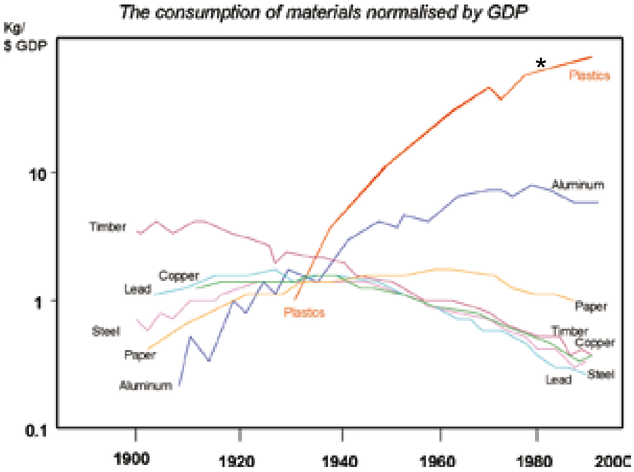


Polymers are an integral part of nature and are everywhere in our daily life. Natural polymers like cotton, sisal, hemp and other natural fibres have been with us since time immemorial and even our own DNA is a polymer. The first man-made polymers were produced over a century ago from latex and cellulose. They were used in products like adhesive tapes, photographic films, rubbers and sponges.

The latter half of the 20th century saw the emergence of a rapidly developing third wave of polymers, which were based on petroleum and produced by the petrochemical industry. These materials have provided the basis for the large-scale expansion of the use of polymers 'for everybody, everywhere'. They have made a major impact on everyday life in the form of packaging (bags, crates, pallets), waterproofing (tarpaulins), roofing, clothing and materials providing thermal or electrical insulation. There has been rapid growth in the plastics and rubber industry that processes these polymers into parts and end products.

The polymer world in the Netherlands and Europe is facing a number of challenges. There is a growth in market demand in terms of both volume and performance. The range and quality of technological options driven by modern science and technology are rapidly increasing. And there is strong pressure from society for sustainability and new technological solutions.

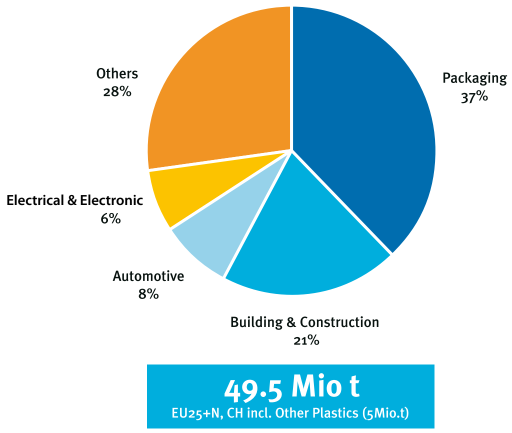
The consumption of materials normalised by GDP



*) Gross Domestic Product

Adapted from source: research carried out at the Rockefeller University in New York

Demand by converter by End Use Segment



Source: association of Plastics Manufactures Europe

The challenges are too broad and scientifically too complex to be addressed by single parties. In addition, change and growth are needed fast, given the fierce international competition and rapid global developments. Since the polymer industry and polymer science are still very strong in Europe, not least in the Netherlands, there is thus an opportunity now for providing such new growth to the existing polymer industry and for helping new polymer-based businesses get off the ground. This growth will be in jobs, in economic terms and in new benefits that polymers can provide. Seizing this opportunity will fortify the Netherlands' position as a knowledge-based economy.

To keep the playing field level, a long-term, public-private partnership was set up in polymer science and technology, with a focus on the new challenges. This partnership involves the leading polymer industries and public polymer research centres in Europe and is publicly supported in the Netherlands and abroad, to have the right scientific, industrial and societal impact in this part of the world.

With the government's policy of supporting innovation initiatives for a longer period of time and its continued support to the Dutch Polymer Institute as the leading organisation in Europe for pre-competitive polymer R&D, it will be possible for the polymer industry to continue and strengthen its future role as a significant contributor to the earning power of the Netherlands.

Polymers powering sustainable economic growth

The ambition of the Polymer Innovation Programme (PIP) is to facilitate a great forward leap in the contribution of polymers to quality of life, sustainability and economic growth. More specifically, 2.4 billion euros extra added value to the chemical industry in 2017 and 30% to the target of the chemical sector to halve the use of fossil fuels by 2032. The PIP is one of the pillars of the chemistry key area of the Ministry of Economic Affairs.

The polymer programme

Dutch industry and government are investing heavily in the research and application of polymers and plastics. The PIP aims to keep the Netherlands at the front of industrial, scientific and social development. The programme has three tracks:

1. the accelerated creation of new business
2. carrying out pre-competitive research and joint development
3. securing a vital polymer community in the Netherlands as a driving force for future growth.

The first and third tracks are being performed by the DPI Value Centre while the Dutch Polymer Institute is responsible for carrying out track 2.

Carrying out pre-competitive research and joint development

This track is at the heart of the PIP. This research programme builds on the work and network of DPI. Its aim is to form a European Centre of Excellence, based on undisputed scientific quality, a sizeable number of patents and intellectual property with significant potential for valorisation and the vigour to attract and supply top talent. This track must also ensure that the Dutch polymer community is involved in European knowledge institutes and companies of the highest quality.
In the research, the focus lies on the following four themes:

1. Durable high-volume performance materials
2. New polymers with properties that contribute to sustainability
3. Coatings and membranes with high added value
4. High-tech and biomaterials

These themes have been selected for their expected contribution to:

- further improvement of the quality of life through the use of material technology
- more sustainable energy-efficient materials with a view to the rising scarcity of raw materials and energy
- new economic opportunities through boosting competitiveness for the Dutch and European polymer industry

1. Durable high-volume performance materials

Demand for materials for housing, transport, packaging and consumer products just contributes to rise and thus the need for new materials with better product properties and environmental performance. This theme contributes to the development of such materials. Hybrid materials with unique properties can, moreover, generate breakthroughs in security (new armament), space exploration and building & construction.

2. New polymers with properties that contribute to sustainability

The production of polymers is becoming increasingly based on green and renewable raw materials and processes, which requires a shift from petrochemical to biochemical processes and products. This shift contributes to the sustainability of society. Additionally, new light and strong polymers lead to new plastics that save on energy and weight or extend the shelf life of food.

3. Coatings and barrier films with high added value

This theme concerns the development of coatings with good environmental and material properties, for instance by being water based. Application results in environmental gains and better protection of consumer products. Barrier film technology breakthroughs will produce improvements in packaging materials, consumer products. Barrier film technology breakthroughs will produce improvements in packaging materials, water treatment and medical treatment.

4. High-tech and biomaterials

These products, known as functional polymers, find their way into all kinds of applications such as small monitors and displays, intelligent security labels (RFID), packaging products and medical products. Collaboration with other research fields (medicine, food) is essential for this.

In addition to the various themes, this track has opted to further develop a number of techniques that support the research of the four themes. These are catalysis, multi-scale modelling and high-throughput experimentation.

Joint development

The activities within this track centre on realising the growth and social targets, the sustainability agenda, of the PIP. The objectives of joint development are:

- to develop and apply new materials and material technology
- to enable breakthroughs for the application of biomass
- to bring improvements to the recycling of current and new polymers and products made from polymers
- to force through the substitution of materials by new materials with improved environmental properties (composition, weight)
- to reduce the energy consumption in the production and processing of polymers

DPI contributes to this by organising workshops, developing joint programmes, building consortia around a particular theme and monitoring progress.

Sustainability central

Through the PIP the Dutch Polymer Institute makes a significant contribution to making the chemical industry and society more sustainable, first and foremost by replacing fossil raw materials with renewable raw materials. DPI is doing this together with the federation of the Dutch Rubber and Plastics industry (NRK) and the Platform for Green Raw Materials (PGG). The effect of renewable raw materials will accelerate after 2012 when the precompetitive research programme of the PIP bears fruit.

DPI also expects a lot from developments within biotechnology and cooperation with the successful NRK programme `replacement and dematerialisation´. The reuse of raw materials is the third route to sustainability in which developments are occurring at rapid pace. The PGG has developed proposals for the ten most used plastics. DPI is working with the NRK to find possibilities for applying used rather than new plastics.

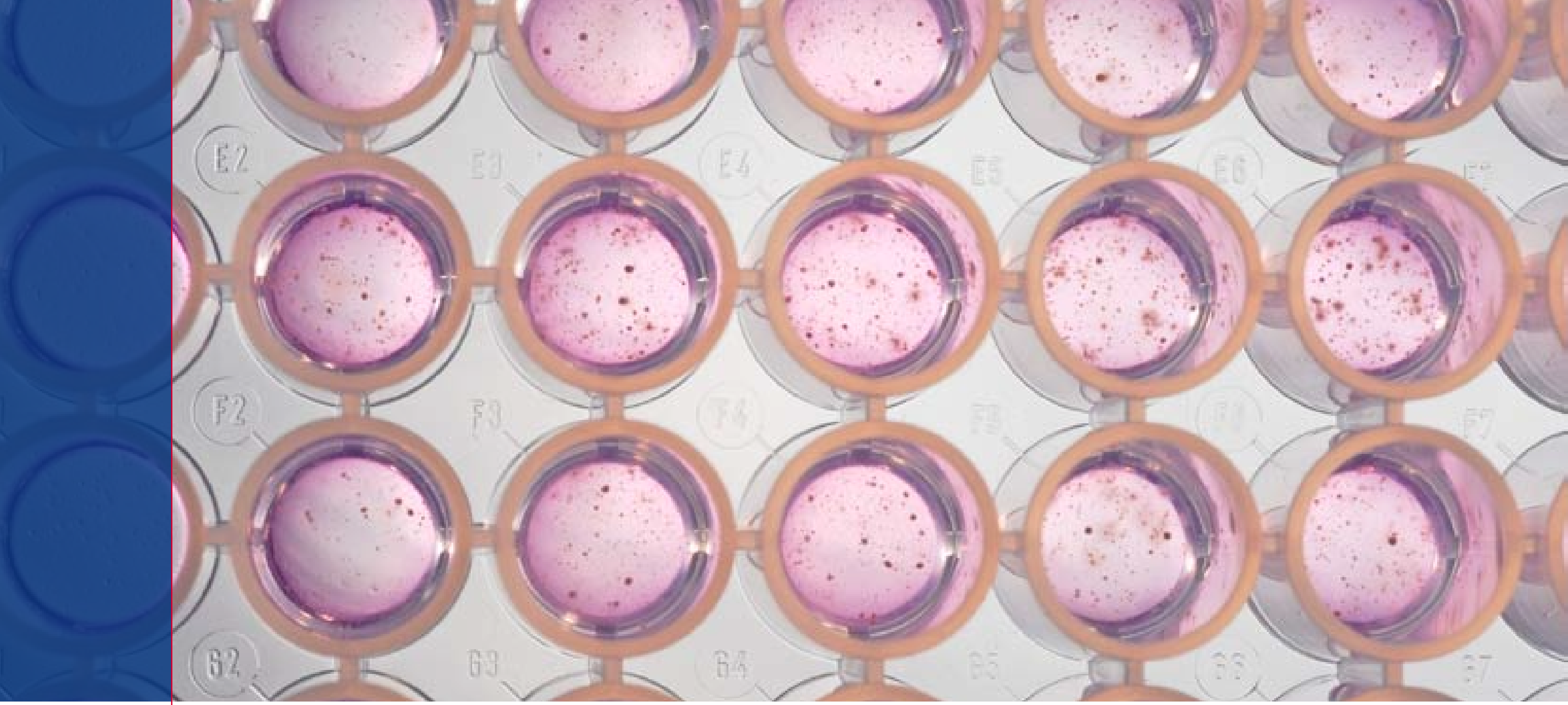
Organisation

DPI is responsible for implementing these activities. DPI is a small organisation with a substantial network. The industry within this network decides the `what´ in terms of research. Researchers determine the `how´. The resulting research programme is coordinated and steered per sub-theme by a Programme Area Coordinator in consultation with a Scientific Chairman. Together they monitor the progress and output of the research and present this to the Programme Committees.

DPI has a Scientific Reference Committee, in which scientists with an excellent scientific reputation have a seat. They advise about the intrinsic research agenda and scientific quality of the research. The Programme Area Coordinators are responsible for attracting new partners.

Budget

In December 2007 the government allocated 49.55 million euros for executing the PIP in the next four years. Of this, 36 million euros is for research (track 2) and 13.55 million for new business and new companies, strengthening the valorisation from the



research programme, community building (tracks 1 and 3) and the programme bureau. DPI and the government are now discussing a rolling finance model to ensure continuance of the programme.

Context

The position of polymers in the chemical industry

Polymers are a key sector within the Dutch chemistry industry, accounting for 40% of its added value. These materials form the raw materials for the plastics industry and comprise a chain with very high added value: from bulk chemicals to the production of raw materials and the conversion of polymers in components for consumer products.

The sector contains around 1550 companies in both the manufacture of the polymers and the processing in or into end products and/or semi-manufactured goods. These companies employ a total of 57,000 personnel. The income from polymers of multinationals with key activities in the Netherlands totals around 11 billion euros annually and the turnover of plastics processing companies is another 6.5 billion euros annually. Polymers and plastics have high added value (30%) compared with the chemical industry as a whole. The sector is also labour-intensive.
Polymers R&D in the Netherlands account for a relatively high proportion: € 450 million.
Total expenditure in research and development in the Dutch chemical industry is 1.4 billion euros.

In brief, the polymer and plastics sector is particularly important for the Dutch economy: it is one of our country's most innovative sectors.

Polymers are crucial for sustainable development

The polymer sector plays an indispensable role in achieving sustainability targets. Polymers and plastics contribute to improving the 3Ps: People, Planet, Profit. The materials are vital to realizing the goals of the government in the field of sustainable economic growth. Developments in the polymer sector are thus driven by major social trends: safety, health, energy efficiency and the battle against global warming.
In each of these areas the materials make unique functional applications possible:

- food packaging for longer shelf life
- coatings that protect products so that they are more durable
- light and strong products that save on fossil raw materials; each kilo of weight saved in the car, for instance, saves 15 kilos of fossil fuel per car
- biopolymers and biodegradable plastics for biomedical applications
- plastics that enable sustainable and energy-efficient constructions in the building trade

Example

Biobased coatings

Certain polymer compounds of coatings for cars, washing machines or computers will in the future no longer be based on petroleum but on biological material from maize, for instance. Research at the Eindhoven University of Technology points to biobased coatings having equally good, if not better, properties as existing coatings. The biobased coatings developed in Eindhoven are less susceptible to decolouration, for example. DPI investigates biobased polymers.

Prof. Piet Lemstra
Dean of department of Chemical
Engineering and Chemistry
Eindhoven University of Technology

"DPI: the ultimate entanglement between academia and industry."

Appendix I

DPI's new polymer research programme

Contributing to quality of life, sustainability and economic growth

The selection of research themes on which the DPI partnership focuses in the years 2008-2015 is based on the potential of the research in question to contribute to:

- a further improvement of the quality of life in a global society that is increasingly becoming dependent on materials technology
- a sustainable materials and energy economy in the light of severe resource and environmental constraints
- new economic opportunities and long-term competitiveness for polymer-based industry in the Netherlands and Europe

In view of DPI's mission of building a bridge between scientific excellence and industrial needs, a further criterion for focusing the agenda should be the opportunity for implementing new and competitive technology based on the latest insights and developments from academic polymer science, which is still very strong in the Netherlands. These insights and developments centre around topics like molecular understanding, nanoscale manipulation, nature inspired chemistry, smart functions, large-scale computing and advanced instrumentation. Such topics will, moreover, enable fruitful synergies to be achieved from the interaction with government-supported innovation initiatives outside the polymer field, which will only enhance the overall economic and societal impact.

Objectives of the new research programme

The expected results of the programme are science meeting high international standards with a high level of patents and inventions per investment and a high level of IP leading to business. In so doing, we will attract top talent and deliver world class researchers and gain the involvement of major top European knowledge institutes and business in related areas.

Figure 1: Specific objectives

Objectives
Contribution to the 30% growth ambition in the next ten years
Selection of projects aimed at joint future agenda of society and business
Selection of high quality scientific projects
High international academic ranking following Centre for Science and Technology Studies (CWTS) method
Number of filed patent applications and inventions
Number of fellowships and affiliations
IP leading to business
Number of partners (government, knowledge institutes, businesses)
Attraction of top talent
Talent transfer to industry
Attraction of high tech SMEs

Figure 2: The four research themes and their objectives explained

If we apply the selection process to high-volume, thin-film, functional polymers and sustainability, we can identify four main focal themes, each with its own main objectives and justification.

	Quality of life	Sustainability	Economic growth
Theme 1: Design of durable high-volume, high-performance materials			
Objectives	New technological options in housing, transportation, infra-structure, packaging, sports	Energy and raw-material savings	New S-curve for high-volume producers and end-users
Justification	Materials solutions needed for rapid human and urban development	Finite availability of resources	Manufacturing industry needs new knowledge base in fierce worldwide competition
Theme 2: New polymers for sustainability			
Objectives	New products from bio-based monomers or with nature-inspired properties	Replacement of fossil feedstock	Create new bio-inspired/ bio-based options
Justification	We still cannot create materials with the same performance as the materials found in nature	Pressure on the use of fossil feedstock	New markets offering new opportunities
Theme 3: High-value-adding coatings and barrier films			
Objectives	Protection of material integrity and food quality, new options from combined functionalities	Improvement of material and product durability, employing renewable feedstock, more sustainable coating processes	Strengthening and expanding existing markets, new markets from high-added-value technologies
Justification	Safety, shelf life, self-cleaning, hygiene in he workplace, smart functions in packaging	Materials savings through better and longer protection, deepen structure-property understanding for material and energy savings, solvent removal	Increased high-specs demands in high-value-adding coatings and films, ability to meet rigorous regulations, cost savings
Theme 4: Materials for high-tech and (bio-)functional applications			
Objectives	Create new ICT, energy, medical nanotechnologies	Polymer-based photovoltaics, large-area and efficient solid-state lighting, enabling components for new battery/ fuel-cell technology	Create options for new products in breakthrough markets
Justification	Paradigm change deriving from polymer-based (bio-) functional nanoscience	Low-cost polymer processing and flexibility or polymeric materials will help increase acceptance of non-fossil based energy generation and storage	Share rapid worldwide developments, based on strong regional knowledge position

Main focal themes

Within and across the four themes a number of separate research topics can be identified that are envisaged to remain leading research topics with strong internal synergy for the full eight-year period; this synergy is based either on a general application direction, a pervasive competence or the generic underlying science.

The following research topics have been defined in close consultation and agreement with major industrial players active in the field for each of the focal themes.

1. Design of durable high-volume performance materials

Molecular control of polymers for high performance

The distinction between different classes of high-volume polymers such as polyolefins, engineering polymers and elastomers is diminishing and their roles and market volumes as performance materials are rapidly increasing. Research has contributed to this by providing a deeper understanding of the synthesis, processing and microstructure of these materials, and a broader toolbox for modifying and upgrading existing materials to achieve a higher performance and a correspondingly wider field of application. The challenge is now to reduce the use of feedstock and energy, and to meet the increased demands in terms of volume and performance of such high-performance polymeric materials on the basis of a real molecular level approach towards their behaviour at all stages of their lifecycle.

Application fields

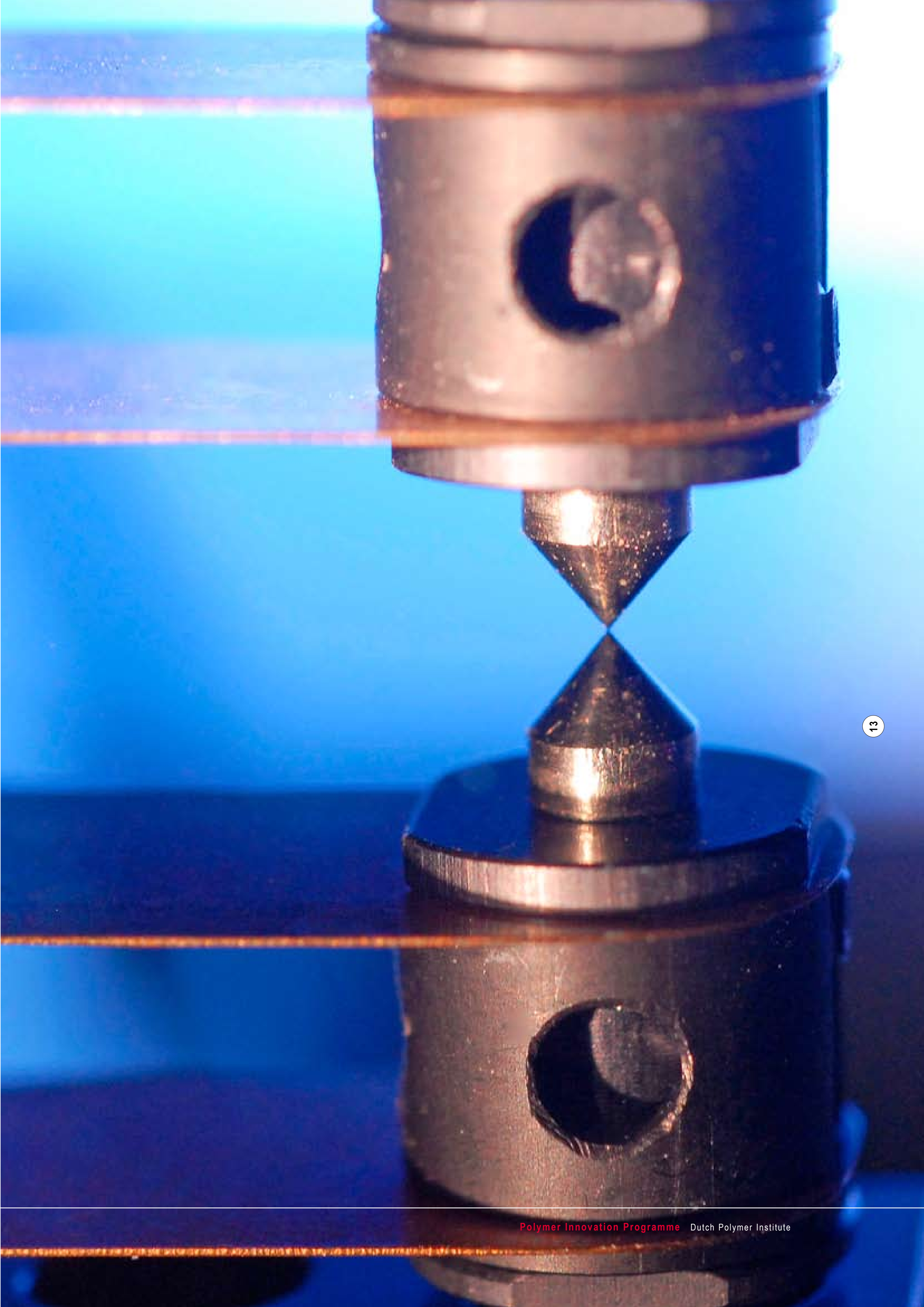
The results of this programme will contribute to greater sustainability in a large field of material application: better technological performance combined with higher resource efficiency in the still exponentially growing market of lightweight materials of construction (e.g. for housing, transport, infrastructure, packaging as well as consumer and engineering products). This market is driven by the global needs of human and urban development, and such new technology may also provide an important new competitive position for the current producers in the European region.

Nanostructured and microstructured hybrid materials

The ultimate properties of bulk polymers critically depend on the microstructure and properties at scales in the nanometre to micron range. In principle, this can be used to aim for high ultimate performance via polymeric materials that are heterophasic at these scales. In particular, the combination of phases may generate synergy effects. The use of a second phase of dispersed organic or inorganic nanofillers may not only lead to greatly increased mechanical properties, but also add new functionalities, like conductive or antistatic properties needed for EMI shielding or paintability. Much progress has already been made in all these respects with both all-polymer and hybrid materials, including the use of block copolymers and blending or reactive processing of polymers with fibres, mineral particles, conductive salts and carbon nanotubes. New knowledge and capabilities in the fields of of nanoscale processing, self-organisation, multiscale modelling and characterisation may give a further boost to this area and lead to new products that offer new economic opportunities in the high-volume market.

Application fields

The general application field and contribution of this topic are similar to those of the previous topic, but the applications are more focused on extreme performance, as in critical load-bearing structural parts, where the replacement of other strong materials by lightweight polymer-based products may give added advantages in production costs and energy consumption. New materials with unique combinations of extreme properties may, moreover, give industry and society new options for demanding applications like safety and security (new forms of armour protection), aerospace and civil engineering (much larger lightweight structures).



2. New polymers for sustainability

Polymeric materials from biofeedstock and bioprocesses

In order to achieve a substantially more sustainable materials economy, polymers from fossil-feedstock based monomers need to be economically and effectively replaced by sustainable biopolymers in high-volume and high-performance applications. The use of a different feedstock, with molecular interactions and structures typical of biomaterials, entails a new understanding and a new knowledge infrastructure in the field of microstructure processing-property relationships, application performance and degradability. At the same time there may be potential for new combinations of advantageous properties in such a new class of performance polymers. The use of biofeedstock and bioprocesses in polymer synthesis, and insight into the methods of nature, may even open up a field where new building blocks, catalytic mechanisms and reactor concepts lead to fundamentally new products, functionalities and applications as well as unexpected product-chain economies.

Application fields

A sustainable materials economy demands that we use polymers based on biofeedstock and bioprocesses to create alternative products in many markets that are now being served by petrobased polymers. The biological origin of the polymer product may also give rise to new products with new applications in the food, health and medical worlds. The emerging nature of the field implies that new materials technology based on biopolymers will create many new commercial opportunities - both for the existing production industry and for new economic activities.

3. High value-adding coatings and barrier films

Polymer coatings for durable applications

Polymeric coatings have a high added value in terms of general materials durability, but their complex composition, the application process and the interaction with the substrate limit the degree of control over their final protective properties and lifetime. New insights based on molecular, colloid and interface science and curing chemistry will be needed to further increase coating performance by design. In addition, there are safety and environmental issues to address (related to toxicity and UV-curing reactions), and fossil resource-based monomers and solvent-based application processes need to be replaced by more sustainable alternatives. Bio-based materials are increasingly becoming cost-competitive against fossil resource-based products. Modern polymer and nano science tools, moreover, provide new opportunities to significantly enhance the performance and application range of coatings byengineering their surface structure and ultimate properties.

Application fields

Applications based on new scientific results on this topic will significantly increase the market share of environmentally friendly waterborne and powder coatings and reduce the environmental impact of solvent use. Coatings with a much better performance and lifetime will also promote the durability of nonpolymeric materials, in particular in high-volume applications in the construction and automotive industries.

Foils and surface films with designed and controllable transport, barrier and functional properties

Thin polymer foils and films are increasingly being used for the safe, smart, flexible and economic packaging of other products. If the properties of such packaging films can be tuned to the critical demands of high-end applications (e.g. in the food, medical, pharmaceutical and electronic markets), this will generate a very high added value and will open up new economic options. To this end, the structural and transport/barrier properties of the films will need to be accurately tuned to the levels desired for storage and service conditions, through micromorphology control. The potential of such high-end packaging films can be further boosted by integrating these properties with functional optical and electronic properties, such as sensing and display. A second area where thin polymeric films with pre-designed microscopic structures and transport properties may become very relevant is in selective mass transport and controlled release of molecular species, as in nanomembranes, and in self-repairing and bio-active coatings.

To realise the long-term potential of polymer films in these respects it will be necessary to adopt a truly bottom-up, molecular-level approach and develop a patterning toolbox.

Application fields

Control over the transport of molecular species in polymer foils and films will significantly increase the range of possibilities in various market applications, including separation technology, water treatment, safe food packaging, sealing of optical-electronics components for a longer lifetime, medical implants with bio-active coatings and nanomembranes.

4. Materials for high-tech and (bio-)functional applications

Polymers for information/communication, luxury products and medical devices

Functional polymers are believed to create a new enabling technology for information processing, with huge economic prospects for wearable, thin-film and miniaturised devices. The first successful applications are to be found in products like electro-optical films for small displays and in micropatterned optical films for polarisation and external efficiencies.
A range of other prototype applications have also been demonstrated. Promising subjects for further development of concepts and prototypes are higher-resolution and full-3D optical patterning, large-area and flexible surface nanopatterning/printing technologies, all-polymer electronics and sensor/actuator functions. This rapidly growing field of electronic and switchable polymers is becoming an enabling technology for the food-packaging, medical and bio-medical worlds as well: by linking up with well-chosen important developments outside the polymer field, like molecular diagnostics and regenerative medicine, food fillers and in RFID technology, the development of the enabling organic-electronics technology may lead to new effective and efficient polymer-based medical, health care and food technologies. However, these subjects still need longer-term research to overcome important fundamental hurdles with regard to the design and synthesis of new materials, new structuring and processing methods, and mechanistic insight into the performance of materials under device operating conditions.

Application fields

The scientific results of this topic will find their application in sensing biomaterials, light management for solar cells, solid-state lighting and LC displays, driving circuits for flexible displays, anti-theft and tracking/tracing tags, data storage and controlled drug release. Plastic electronics is just at the beginning of a revolution of applications, and huge research and infrastructure investments are being made worldwide to create competitive regional advantages.

Materials and devices for new energy and lighting technologies

New energy conversion, storage and distribution technologies and more energy-efficient lighting technologies are imperative to meet society's growing consumption needs and sustainability requirements. Functional (semi)conducting and proton/ion-conducting polymers offer the prospect of combining excellent performance with low cost, light weight, and ease of processing. The areas of organic and polymer solar cells and white-light emitting diodes have witnessed enormous advancements recently, providing efficiencies that show high potential for these novel technologies. Concerted and focused long-term research programmes will be necessary to continue achieving scientific and technological breakthroughs. These will originate from an improved understanding of the relationship between molecular structure, self-organisation, and optical and electrical properties on all relevant length scales, in close combination with the application-motivated development and investigation of novel prototype devices and their manufacturing technologies.

Application fields

Applications of this research will predominantly address the ambient-lighting market and the societal need to increase the use of solar energy. An additional field in which this topic is likely to open up new options is energy storage, like fuel cells for transportation and batteries for wearable electronics.

Pervasive enabling research competences

The role of pervasive competences

In the rapid development of polymer science and technology for divergent applications, a number of enabling competences can be identified that have been and still are both generic and critical. This implies that these competences will continue to be actively employed in the various application topics in DPI's future research programme. At the same time these competences themselves are showing important progress as scientific and technological fields in their own right; such progress is often triggered by specific application needs (e.g. from the polymer field or other materials fields) but may in turn enable much wider application breakthroughs. For DPI's future portfolio, with much emphasis on bottom-up design of materials and functions via molecular and nano-scale insights, a large variety of molecular and nano-size building blocks, and a large window of process and performance parameters, we have identified the following critical pervasive competences:

1. Catalysis
2. Multi-scale modelling and characterisation of microstructure and performance
3. High-throughput experimentation

Activities involving the application of these three competences will undoubtedly appear in the DPI programme. But to give this more substance, and to enable and safeguard new possibilities in these pervasive topics, more generic state-of-the-art research has to be guaranteed as well, in both the development and demonstration of method. Depending on industrial interest this may be organised either in a separate Technology Area or as a corporate programme. An added advantage of such a competence-based programme is that it may provide a distributed network of infrastructural facilities in fields which often require large investments in modern and operationally complex hardware.

1. Catalysis

Polymerisation catalysis is a supportive competence for research on all classes of polymer-based materials. It comprises homogeneous catalysis, heterogeneous catalysis and biocatalysis and is a crucial and indispensable tool for:

- improving the process economy and product performance of existing high-volume performance polymers, coatings, fibres and films
- developing new, environmentally benign and sustainable processes towards such polymer products
- developing special, new functional materials for, among other things, biomedical and electronic applications

In particular, this topic involves the development of environmentally friendly catalysts and catalytic processes for free and controlled radical polymerisation in emulsion and solution, and of new catalytic processes for performing coordination polymerisation in emulsion. The application of thermally fairly unstable renewable and sustainable monomers requires the development of new generations of catalysts, preferably using high-throughput experimentation (HTE) techniques. In addition to the HTE technology, the future design and development of new catalysts and catalytic processes will increasingly rely on modelling expertise, and an active interplay between modelling and experimental expertise in one and the same research programme will be crucial. The design and implementation of improved catalysts and catalytic processes will reduce energy consumption and chemical waste as well as enhance process and product control.

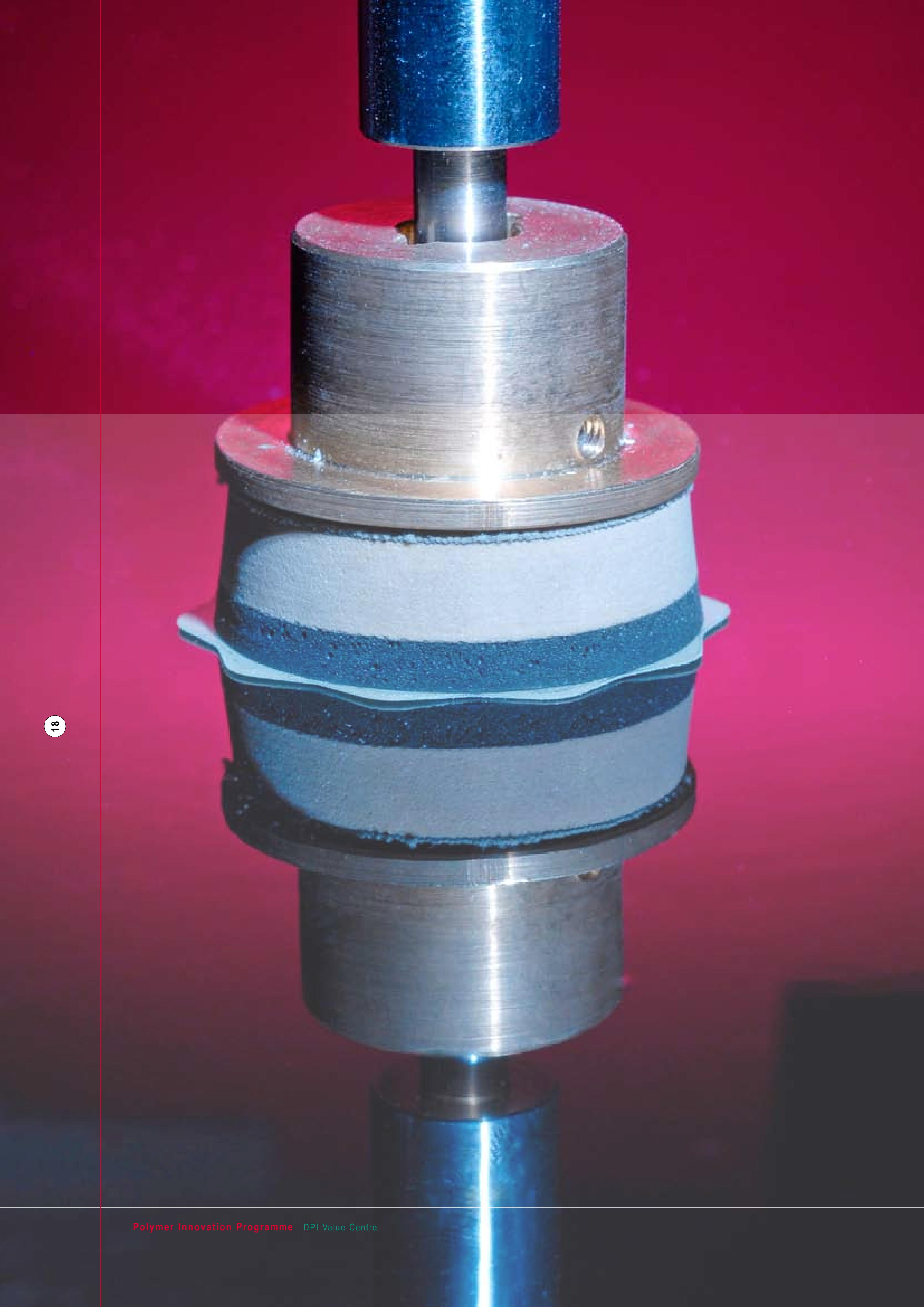
2. Multi-scale modelling and characterisation of microstructure and performance

An essential requirement for the knowledge-based design of polymeric products, and for controlling and tuning the properties of these polymeric products to the demands of the application, is insight into the triangular relationship between the material's microstructure, its temporal development under external conditions and its properties.
The natural architecture and dynamics of polymers,

with different structural organisation at different length scales, and a correspondingly broad range of characteristic time scales, implies that such insight is needed from beyond the microscopic scale down to the molecular scale. Catalytic and functional properties extend this requirement even to the scale of sub-molecular and electronic processes. Modern theoretical and modelling research, computer and computing developments, and the spectacular new possibilities for microstructure analysis with near-atomic and chemical resolution, increasingly offer the tools to meet these requirements and such developments will continue at a fast rate. It is important now to expand the already existing DPI network of modelling and characterisation competences in this area into an integrated enabling programme that can incorporate all essential methodologies. Such a programme should aim at bridging the different length and time scales, and thus provide a basis for bottom-up design of polymeric products from molecular and nanoscale science towards macro-scale performance.

3. High-throughput experimentation

High-throughput experimentation and combinatorial materials research open the way for full and fast polymer research workflows to rapidly investigate polymers and polymeric products that show systematic variations in their composition, processing parameters or property profiles. This will lead to defined libraries of polymers having targeted molecular structural and functional properties at surfaces and in bulk and thin-film products. Industries are confident that in the short term the high-throughput methodology will enable significantly faster fundamental breakthroughs in the search for new polymer performance, with access to an increased parameter search space. Moreover, the improvement of polym-erisation, formulation and compounding processes and the development of new, highly efficient polym-erisation catalysts opens avenues to more energy-efficient, environmentally friendly as well as sustain-able production processes (including the substitution of classical raw materials by bio-based feedstock). In the long term, it is expected that a kind of 'materials informatics' will be developed, which will enable knowledge-based design and preparation of tailor-made materials and devices with predetermined properties based on a detailed understanding of quantitative structure-property relationships.
The high-throughput polymer and materials research approach is strongly influenced by the development of rapidly widening methodologies (such as ink-jet printing, combinatorial compounding or microwave-assisted processes), which will have to be validated and tested for their feasibility, and implemented for breakthroughs in application-oriented research.



Appendix II

The DPI Value Centre accelerates polymer innovation

The DPI Value Centre (DPI VC) is responsible for performing the first and third track of the Polymer Innovation Programme (PIP); the accelerated creation of new business and securing a vital polymer community in the Netherlands as a driving force for future growth.

The accelerated creation of new business

In order to generate new business in the field of polymers, within both science and industry, DPI VC has defined five `lines of action´. These lines of action all contribute to the aims of DPI VC: economic growth, quality of life/sustainability and networking.

Market expansion

The aim of this line is to create new and larger markets for existing and new companies through innovative and rapidly growing business, the development and sharing of ´best-practices´ among (potential) buyers and providers of polymer technology, and the initiation of projects geared to solving future problems (of society). DPI VC contributes to these aims through the organisation of workshops, the generation of ideas, the clustering of parties and advising on intellectual property.

Starting entrepreneurs

This line contributes to more and more successful new start-ups, to the acceleration of the growth of newly started businesses and to consolidating the international network around these companies. In addition to advice on intellectual property, organising workshops and coaching, DPI VC is responsible for customised funding within this line of the various phases of growth, as in the Polymer Technopartner Fund.

High-risk innovation projects

Innovation projects with a high-risk profile require support, for instance in the shape of subsidies. This line therefore makes feasibility studies and project development funding available and DPI VC organises joint workshops, for instance to debate the significance of the design, customer demand and the recommended strategy.

Cross-border corporate partnership with SME

This line contributes to the growth of the polymer sector through the successful commercial introduction of new inventions by actively linking up innovative Dutch SMEs to European projects. The focus lies on cooperation with Flanders and NoordRijn-Westfalen in which the collaboration is drawn to joint programmes and projects.

Collaboration geared to valorisation

This line corresponds with the Polymer Innovation Programme goal of achieving 1.6 billion euros extra growth of the sector’s added value in 2017 by boosting valorisation of scientific research. Collaborative links among companies and knowledge institutions are essential to achieving this goal. DPI VC helps to build and maintain these collaborative links.

Strengthening knowledge and the network

In addition to creating new business, DPI VC focuses on strengthening the competences within and among the collaborating partners in the field of polymers. The aim is to put the Netherlands on the map, raise the level and scope of collaboration within the sector and attract new talent and funds from both domestic and foreign sources. DPI VC achieves these aims through the following two lines of action.

World Polymer Academy

Sufficient and well-educated personnel are vital to the sector. DPI VC advances the Human Capital Roadmap of the chemical industry for collaboration with universities and European partners towards a European approach to filling this need. An initial step has already been taken in the area of polyolefins; European companies are funding a virtual educational programme for employees.

Masterclasses

For individual companies it is not easy to set up and carry out innovation and R&D, perceive opportunities in new markets (sustainability, quality of life) and use new techniques to exploit these opportunities. DPI VC helps companies by bringing them, on their own or together with other partners in the network, in contact with innovation programmes like Food & Nutrition Delta and the Materials Innovation Institute (M2I).

Organisation

DPI VC began officially in the second half of 2007. The organisation is currently fully operational and has a staff of six, a number that increases to ten by 2012.

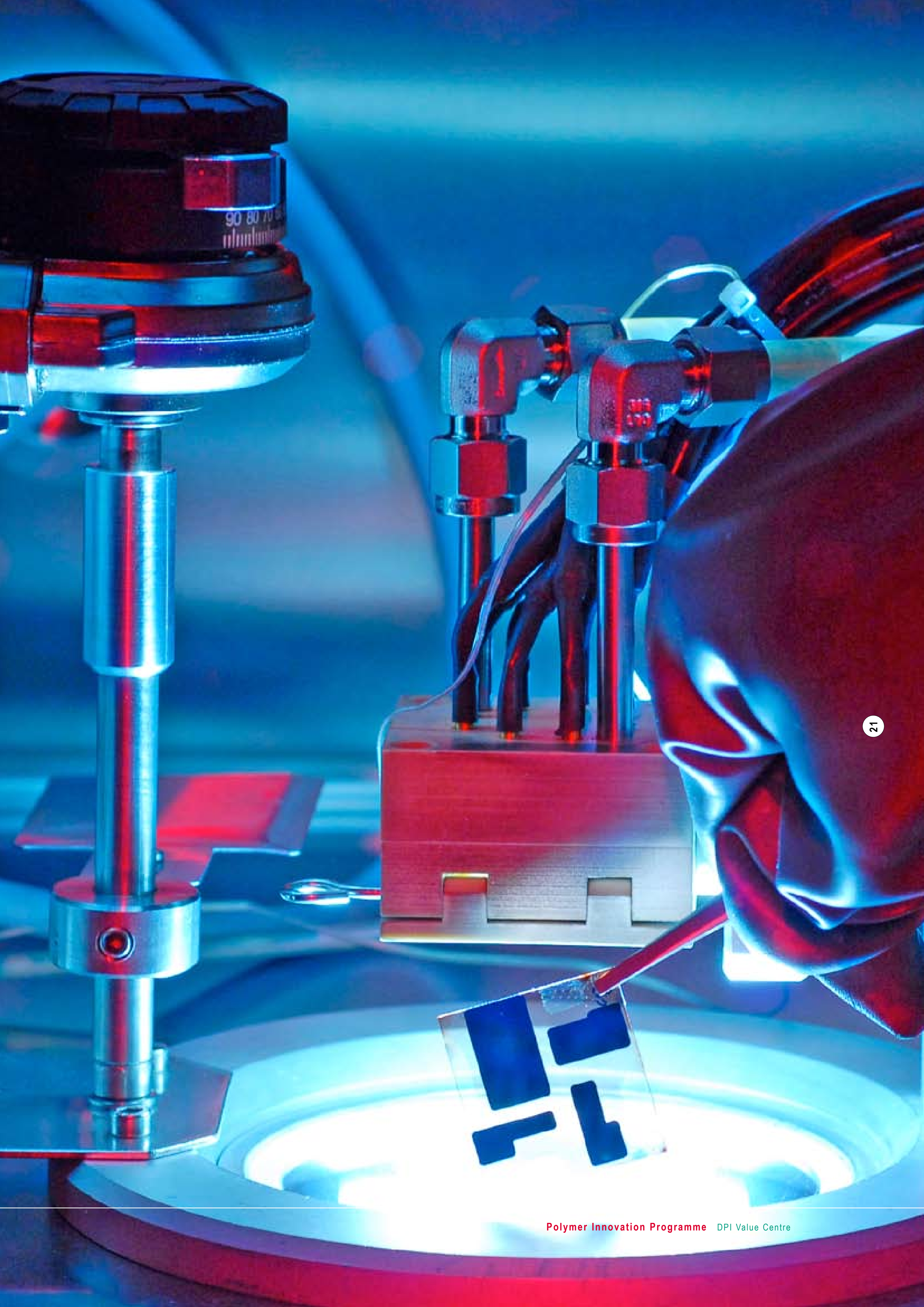
A taskforce comprising stakeholders like the Dutch Polymer Institute, NRK, Syntens, United Brains, Technopartner, Brainport, Polymer Technology Group Eindhoven (PTG/e) and Creative Conversion Factory carefully monitors the activities of DPI VC. The conclusions and recommendations that derive from this will help form the approach of DPI VC for the period 2009-2010.

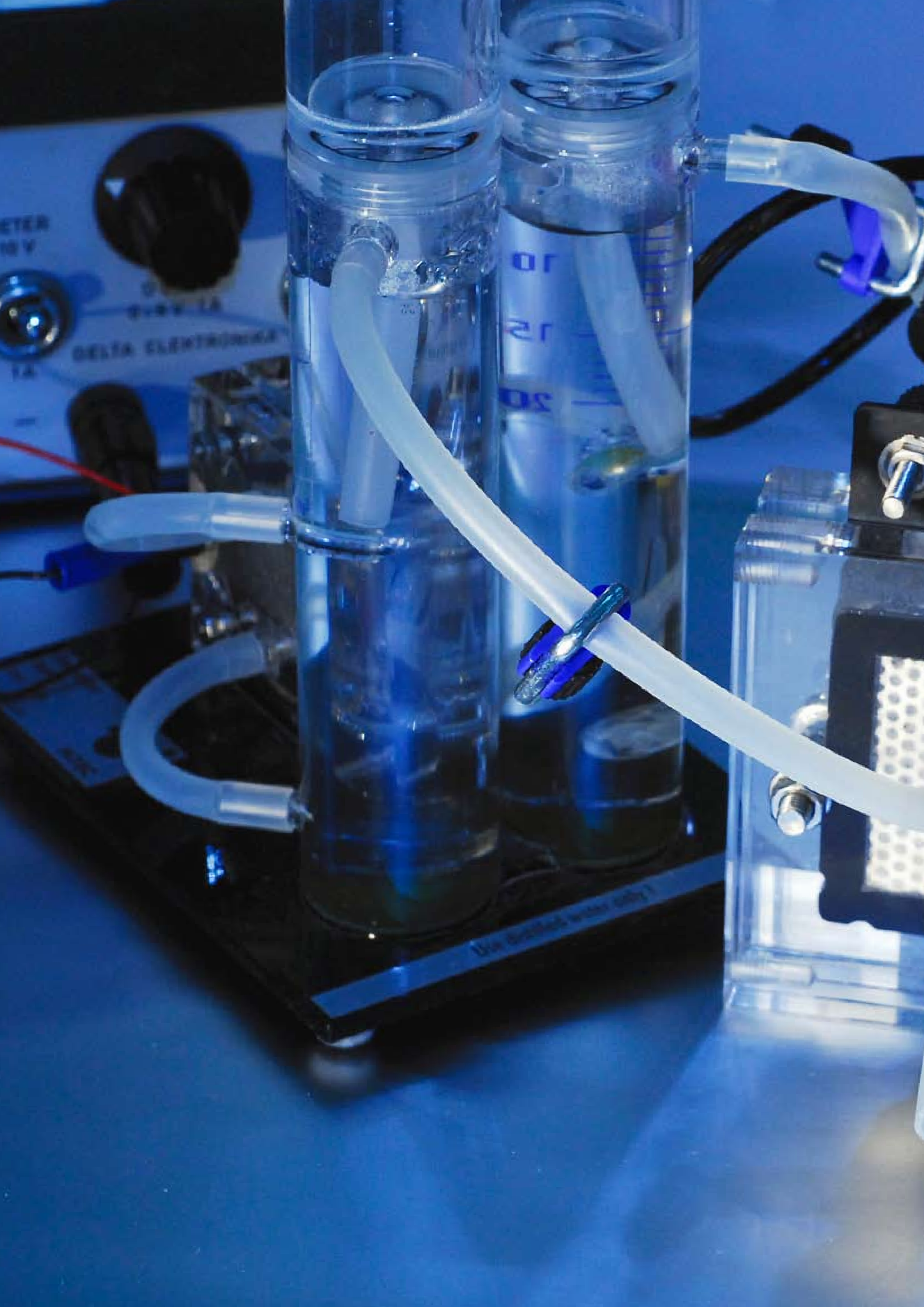
DPI VC was initiated by the Dutch Polymer Institute and is a separate legal entity.

Example

Perkalite

The SME sector is very interested in a new Akzo Nobel filling that offers a more environmentally-friendly alternative for bromine-based fire retarders. It is Perkalite, new synthetic clay by Akzo Nobel. This clay can be added to plastics and rubbers as a fire retarder and as an improver of mechanical properties. It can also result in a thinner foil with improved barrier properties. SMEs in rubber and plastics will be investigating the possibilities of using the clay in their products. DPI VC, Akzo Nobel and the NRK federation have brought these companies together. Currently eighteen companies have begun a follow-up, together with Akzo Nobel and the NRK. This is one of the first success stories of DPI VC in providing start-ups and SMEs with the very latest knowledge of plastics to enable them to innovate more easily.




DELTA ELEKTRONIKA

Dr. Klaas Remerie
Manager, Basic & Explorative Research, SABIC Europe
“For the polymer industry in Western Europe it is very reassuring to observe that the DPI programme positively contributes to a continuous flow of high-quality PhD recruits who have already been exposed to both excellent polymer science and, albeit from a distance, an industry environment. It will help a global company like SABIC to achieve a balanced diversity of staff now and in the future.”

Dr. Gerhard Langstein
New Business, Bayer Material Science
“DPI is one of our academic relations among many others. However, because Germany will face a 30% shortage of well-educated polymer chemists in the near future, Bayer is eager to recruit well-educated DPI researchers.”

Prof. Michael Dröscher
Senior Vice President, Corporate Innovation Management, Degussa AG
“Innovation has two sides: innovation of the innovation process, and bringing science to industry. The Dutch Polymer Institute does both, that is why it is such a special institute.”

Prof. Thijs Michels
Theoretical and Polymer Physics, Eindhoven University of Technology
“For the academic researcher DPI provides a window on a much larger world of inspiring problems. If that is understood well, this form of collaboration with industry stimulates rather than restricts the free flow of creativity.”

Dr. Jacques Joosten
Chairman of the Executive Board, Dutch Polymer Institute
“The Netherlands is very strong in chemistry. If we want to maintain that position, we have to invest to make it stronger. DPI is a valuable instrument in this respect.”