DPI's New Normal

Annual Report 2020

DPI
The Polymer Research Platform

Foreword
DPI's New Normal

2020 was an abnormal year in many ways. The COVID-19 pandemic changed almost everything, including the way we work. Within DPI we were quick to adapt and moved everyone to “home office” in the first week of March. Thanks to the creativity and the resilience of our international academic partners, we were able to keep the research projects going, with only a slight delay where labs were in total lock-down. The polymer industry itself was affected more severely, with a sudden loss of demand, mostly caused by the economic recession in general and a decline in the automotive sector in particular. The first signs of recovery became visible late 2020, but due to the economic crisis and the corresponding generic saving mode in industry, DPI did not get any new participants.

DPI Strategy
Last year, we formulated a new strategy, “Preparing for a Sustainable Future”, which was introduced during the Annual Meeting 2020. Today’s world urgently needs solutions in the area of sustainability and collaborative polymer research will play a key role in enabling these solutions. Although many technology development projects are anchored in existing value chains, we launched *DPI Development* to help speed up the technology transfer process within the larger DPI Polymer Innovation Community. We initiate and run development projects (TRL 4-7) in our programme area *Circular Plastics Initiative* and are ready to do the same in spin-offs from certain *DPI Fundamental projects*.

Besides reinforcing the current DPI Fundamental programme areas *Polyolefins* and *Performance Polymers*, we are targeting to add new pre-competitive industry-based programme areas around *Biomedical Polymers* and *Complex Polymeric Fluids*. Once these are up and running, more areas will follow in the future, as it is our belief that the broad application of polymers needs to be reflected in DPI programme areas. In this way the DPI Polymer Innovation Community will grow in strength and capabilities and also enhance mutual relevance and benefit.

Our *new normal*, therefore, will be to find smart ways to enable the DPI Innovation Community to simultaneously pursue two interconnected goals: maintaining a well-spring of knowledge through fundamental research, while at the same time working on speeding up technology transfer and applied research in order to generate solutions in the societal mission themes.

Circular Plastics Initiative
In 2019 we joined forces with the Institute for Sustainable Process Technology (ISPT) to launch the Circular Plastics Initiative (CPI). In 2020 a new CPI project was initiated: *InReP, Integrated Approach towards Recycling of Plastics*. Subsidy for InReP was granted in April 2021, enabling the 37(!) partners to work on systemic and technological solutions for sorting & washing of plastic waste as well as on improvements in both mechanical and chemical recycling of

polyolefins and polyesters. Besides expanding the programme with additional projects, we are continuing our efforts in further building the International community around circular plastics in the Netherlands and Europe through the Circular Plastics Conference. CPI is built to define, align and research – as well as to develop. And this is where we really want to get things rolling.

Farewell to Prof. Busico
In October 2020 we thanked Prof. Vincenzo Busico for his many years of service as Scientific Chair of DPI's Polyolefins programme and welcomed Prof. Bernhard Rieger, Chair of Macromolecular Chemistry at TU Munich, as Prof. Busico's successor.

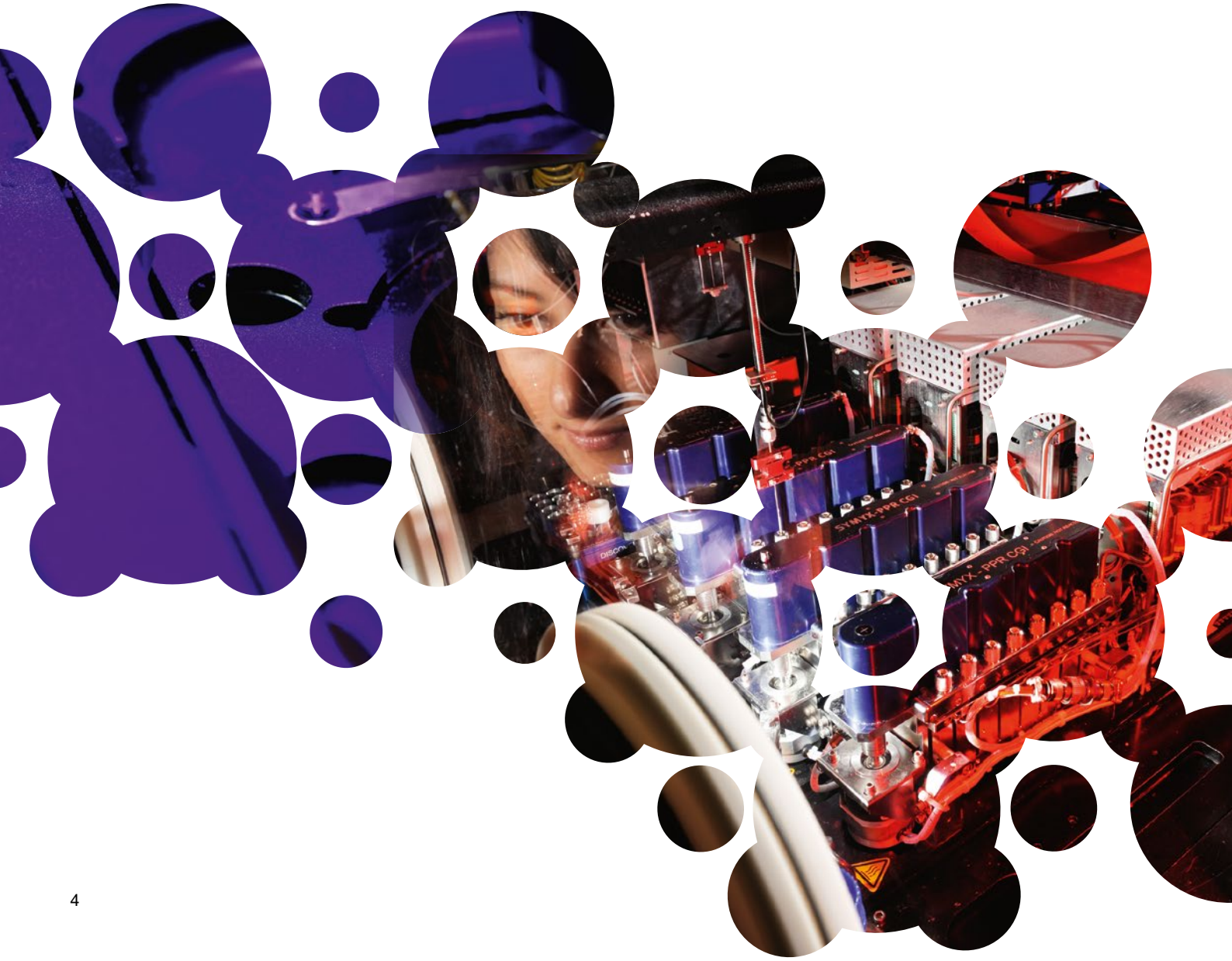
Working on and for the future
DPI Fundamental's core research programmes are focused on pre-competitive areas in which our industrial partners define their needs and can work together without compromising their individual competitive interests. Exploratory initiatives play an important ongoing role in delineating these needs. Taken in conjunction with new developments in science and technology, which we track on an ongoing basis, such initiatives help us to work with the polymer industry to unlock new routes for achieving their common innovation goals. The *new normal* will be that all projects will have sustainability goals. In 2020, many new research projects were already driven by the world-wide and industry-wide drive for sustainability, bringing the number of active projects in DPI Fundamental containing sustainability goals up to one third of the total (15/46).

The new normal
It is our firm belief that the world will continue to need new, lighter, more effective and environmentally sound polymeric materials to meet its changing needs and to sustain a higher quality of life for an ever-growing world population. As we have shown over the past 23 years, DPI has the resilience to continually adapt to changing circumstances, to proactively connect to societal missions and to drive the much-needed advances in research and innovation.

Since last year our community has adapted to the new COVID-19 reality. We realised that international cooperation, across different time zones, has improved in certain ways due to online meetings and conferences becoming the standard. Within DPI we have embraced the online meeting structure and are experimenting with online meeting and conferencing tools to stimulate networking. We realise that in the new normal travel will be restricted at times, and people will be working both from home and at the office or lab. Therefore, DPI needs to invest in conferencing and networking tools, so that our online events and meetings are as effective as the physical ones. In this regard, DPI's *new normal* will be hybrid, with meetings being physical, online or a combination of the two. And, as always, we will continue to adapt!

Ernst Jan van Klinken
Managing Director

Contents



Organisation 2020

Supervisory Board

- **Dr. Y.M.T. Engelen**
  Chair - until March 2020
- **Dr. J.G.H. Joosten**
  Chair - as of March 2020
- **Prof.dr. F.P.T. Baaijens**
- **B. van Leeuwen, MSc**
- **Dr. E. Van Praet**

Executive Board

- **Dr. J.G.H. Joosten** (left in 2020)
  Managing Director, Chair
- **E.J. van Klinken, MSc**
  Managing Director, Chair
- **Vacancy**
  Scientific Director

Programme Area Coordinators

- **Dr. C.L. Bostoen**
  Polyolefins
- **Dr. D.G. Hristova-Bogaerds**
  Performance Polymers
- **R.J. Korstanje, MSc**
  Polymers for Oil and Gas

Scientific Programme Chairs

- **Prof.dr. V. Busico** (Left in 2020)
  Polyolefins
- **Prof.dr. C. Creton**
  Performance Polymers
- **Prof.dr. B. Rieger**
  Polyolefins

Organisation Staff

- **A.F.J. van Asperdt**
  Financial Administration
- **A. Brouwer**
  Programme Manager Seafront
- **L.A.W. Damen**
  Project Administration
  Financial Administration
- **R.P.F. Hoogers-Valken**
  Secretariat
- **P.J.J. Kuppens, AA**
  Controlling
- **Dr. C.H.Lai** (Left in 2020)
  Business Developer
- **R.M.L.E. Peters**
  HR&O Manager
- **C.H.L.M. Scharff-Bastiaens**
  Communications
- **L. de Wit**
  Project Administration

DPI: International Centre of Excellence in Polymers

In the last few years DPI has transformed itself into an International Centre of Excellence in Polymers. To achieve that goal, the institute has expanded its pre-competitive research programme with projects focusing on pre-commercial application themes.

DPI Fundamental programme

DPI's pre-competitive research programme currently embraces three programme areas. Companies and knowledge institutes can participate in one or more of these areas, each of which encompasses a substantial number of projects. The participating companies jointly define the programme content for the programme areas in which they participate. PhD students and post-docs from our partner knowledge institutes perform their research in close collaboration with scientists from our industrial partners. Shaping that collaboration between industry and academia is the key to building a coherent community that delivers research results to the envisaged high standard and prepares our scientists for their future careers, in industry or elsewhere.

DPI Rules & regulations apply to all projects

Polyolefins	Performance Polyolefins	Polymers for Oil and Gas
17 projects	**16 projects**	**4 projects**
Industry • Borealis • Braskem • Dow Benelux • ExxonMobil • Reliance • SABIC • SCG Chemicals • SIBUR • Sinopec **Academia** • CPE Lyon • Eindhoven University of Technology • Ghent University • Japan Advanced Institute of Science and Technology • Leibniz-Institut für Polymerforschung Dresden • Lomonosov Moscow State University • National Technical University of Athens • University of Chemistry and Technology Prague • University of Groningen • University of Naples Federico II • University of Perugia • University of Turin • University of of Winconsin-Madison • Utrecht University	**Industry** • DSM • Hutchinson • Kingfa • SABIC • Saudi Aramco • Shell • SKF • Teijin Aramid **Academia** • Delft University of Technology • École Supérieure de Physique et de Chimie Industrielles (ESPCI) • Eindhoven University of Technology • Ghent University • IFREMER L'Institut Francais de Recherche et d'Exploitation de la Mer • National Technical University of Athens • Polymer Competence Center Leoben • Radboud University • The University of Manchester • University of Bologna • University of Nottingham • University of Oxford • University of Savoie Mont Blanc • University of Twente	**Academia** • Clausthal University of Technology • University of Bordeaux • University of Groningen • University of Twente
Expenditure: € 1.53 million FTEs: 20.7 (30 researchers)	Expenditure: € 1.07 million FTEs: 18.2 (22 researchers)	Expenditure: € 0.26 million FTEs: 3.7 (4 researchers)

DPI Development programme

The industrial pre-commercial programme consists of Value Chain projects. The Value Chain projects offer companies and/or research institutes the opportunity to establish consortia for innovation projects, in which they collaborate within the value chain. Every partner plays an active role in the project, which must be aimed at further development of an innovation. The projects are intended to generate economic activity within the foreseeable future (i.e. no later than two to five years after completion of the project).

DPI's role is to actively assist in establishing the collaboration and to coordinate the project. DPI's role can also be limited to acting as coordinator of a project.

DPI provides a model framework for the collaboration, but the detailed rules are agreed between the members of the consortium. With respect to intellectual property, the basic principle is that the knowledge created during the course of the project (foreground knowledge) is the property of the inventing partner, and any background knowledge contributed to the project remains the property of the partner that provided it. Other partners have free access to the knowledge contributed to and/or generated during the project, but only for research purposes and to the extent necessary for developments in the project. Specific agreements are made to enable access to another partner's IP for commercial application of the knowledge outside the project.

NWO Rules & Regulations apply to all NEWPOL projects

NEWPOL (New Polymer Materials) programme

DPI is working together with NWO, the Netherlands Organization for Scientific Research, on the NEWPOL (New Polymer Materials) programme.

NEWPOL is a public-private initiative focusing on developing new polymeric materials by encouraging cross-pollination between different research fields and disciplines.

DPI has organized the NEWPOL activities as a separate programme area. It offers DPI a good opportunity to explore the possibilities of this model of cooperation.

Industry

- All of DPI's industrial partners are participating in this programme

Academia

- Amsterdam UMC
- Delft University of Technology
- Eindhoven University of Technology
- University of Groningen
- Wageningen University & Research

Project topics

- Colouring paint without pigments
- Commodity polymers with self-organizing smart coatings that respond to environmental changes by changing color and/or shape
- Supramolecular biomaterials for stem cell expansion
- Self-synthesizing gels
- Development of a SuperActive synthetic biomaterial to repair damaged tissues in the body
- Flexible memories made from coordination polymers

Summary of financial data 2020

Income

	(x EUR million)	%
Contributions from industrial partners	2.68	66.2
Revenue Patents	0.06	1.5
Contributions from knowledge institutes	0.05	1.2
Subsidy of PPS Toeslag	1.15	28.4
Value Chain	0.05	1.2
Business Development	0.06	1.5
Total income	**4.05**	**100**

Expenditure

	(x EUR million)	%
By nature		
Personnel costs	3.44	84.1
Depreciation	0.05	1.2
Other costs	0.60	14.7
Total expenditure	**4.09**	**100**
By Programme Area		
Polyolefins	1.53	53.5
Performance Polymers	1.07	37.4
Polymers for Oil and Gas	0.26	9.1
Sub total	**2.86**	**100**
Knowledge Transfer	0.06	
Organisation and support	0.92	
Value Chain	0.05	
Business Development	0.20	
Total expenditure	**4.09**	

Key Performance Indicators 2020

Number of industrial partners

Participation of foreign knowledge institutes
as % of total expenditure

Number of partner knowledge institutes
(universities, etc.)

Overhead costs
as % of total expenditure

Industrial contribution (cash and in-kind)
as % of total income

Expenditure for knowledge transfer
x EUR million

Subsidy (PPS Toeslag)
as % of total income

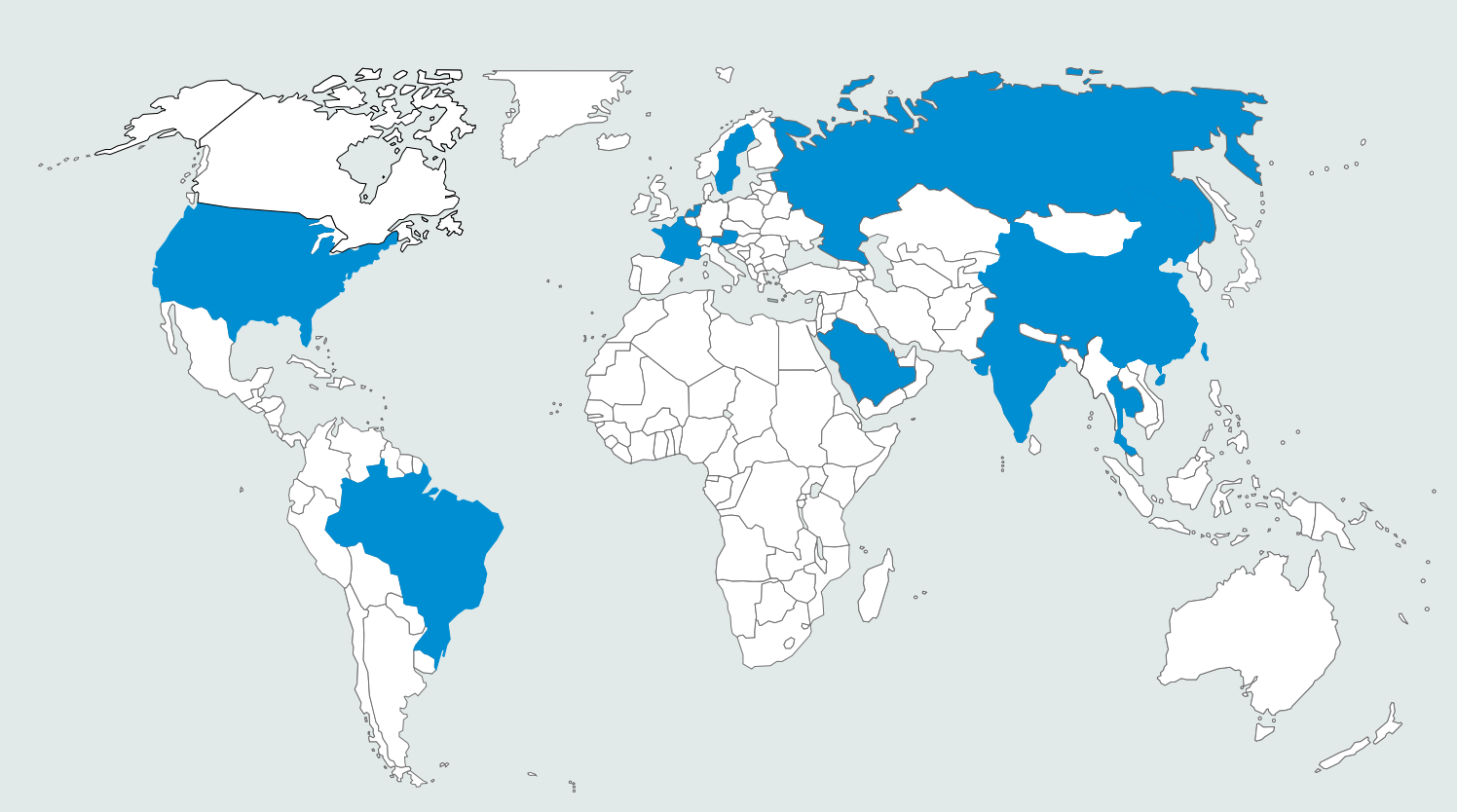
Track record DPI researchers

Left in total	9
Employed by partner knowledge institute	7
Employed by non-partner knowledge institute	0
Employed by partner industrial company	0
Employed by non-partner industrial company or start-up	1
Unknown	1

Research output

	2019	2020
Scientific publications	33	39
PhD theses	4	4
Average journal impact factor	3.83	4.69

Partners Industry 2020



Europe

BOREALIS Keep Discovering	Borealis
HUTCHINSON	Hutchinson
SIBUR	SIBUR
SKF	SKF
SNF FLOERGER	SNF Floerger (left in 2020)

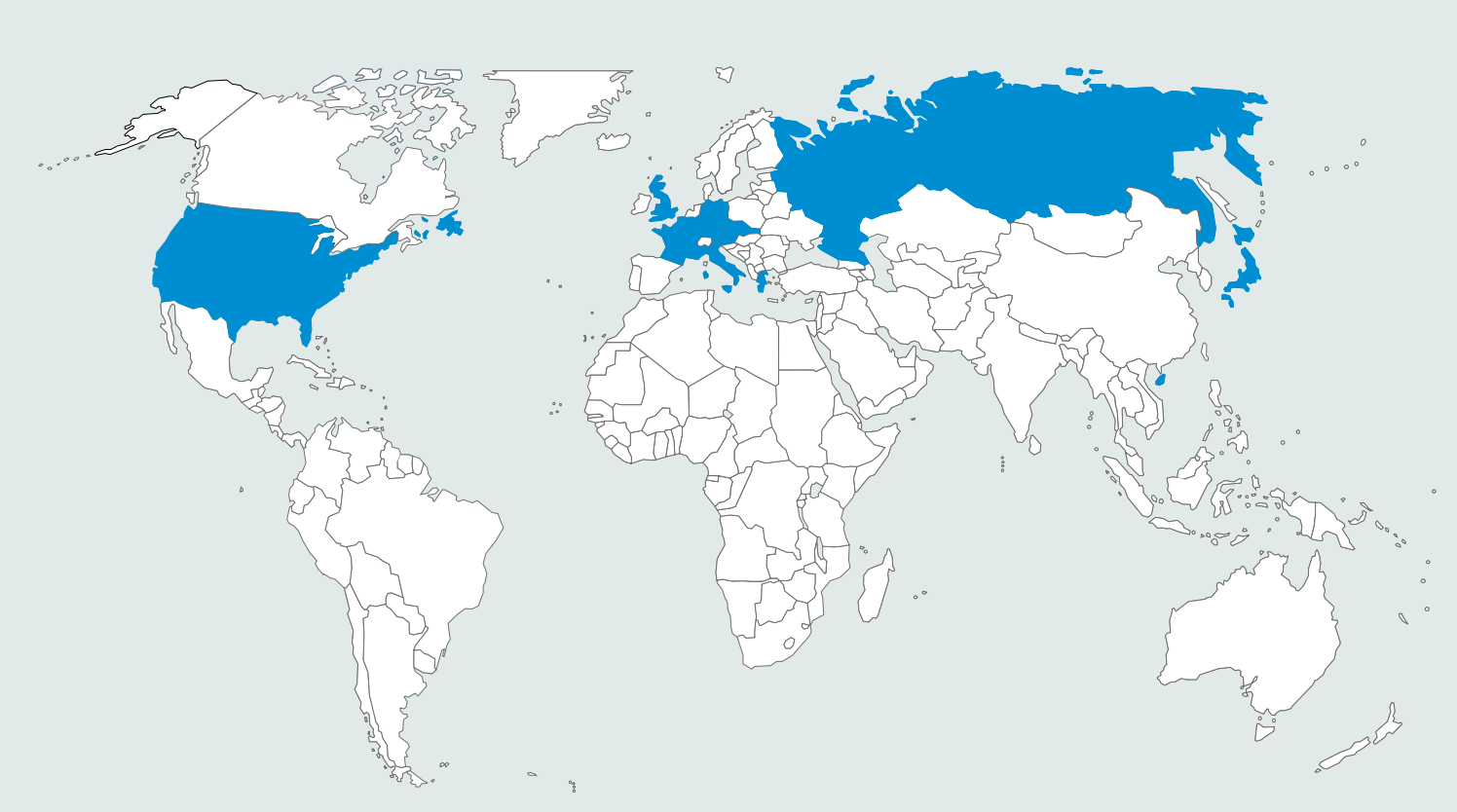
North and South America, Asia

Braskem	Braskem
ExxonMobil	ExxonMobil
KINGFA	Kingfa
Reliance Industries Limited	Reliance
aramco	Saudi Aramco
SCG	SCG Chemicals
Sinopec	Sinopec

The Netherlands

	Dow Benelux
	DSM
	SABIC
	Shell
	Tejin Aramid

Partners Knowledge institutes 2020



Europe

Clausthal University of Technology	
CNRS Strasbourg	
CPE Lyon	
ETH Zurich (no research projects in 2020)	
Fraunhofer Institute for Structural Durability and System Reliability LBF (no research projects in 2020)	
Ghent University	
IFREMER L'Institut Francais de Recherche et d'Exploitation de la Mer (new in 2020)	
KU Leuven (no research projects in 2020)	
Leibniz-Institut für Polymerforschung Dresden	
Lomonosov Moscow State University	
National Technical University of Athens (rejoined in 2020)	
Polymer Competence Center Leoben	
The University of Manchester	
University of Bologna (new in 2020)	
University of Bordeaux	
University of Chemistry and Technology Prague	
University of Naples Federico II	
University of Nottingham	
University of Oxford	
University of Perugia	
University of Savoie Mont Blanc (new in 2020)	
University of Turin	

North and South America, Asia

WISCONSIN	University of Winconsin-Madison (new in 2020)
JAIST	Japan Advanced Institute of Science and Technology
TEXAS	The University of Texas at Austin (no research projects in 2020)

The Netherlands

TU Delft	Delft University of Technology
TU/e	Eindhoven University of Technology
Radboud University	Radboud University
university of groningen	University of Groningen
UNIVERSITY OF TWENTE.	University of Twente
Utrecht University	Utrecht University
WAGENINGEN UNIVERSITY & RESEARCH	Wageningen University & Research (no research projects in 2020)

DPI Annual Meeting 2020

On Tuesday 27 October DPI organised the first hybrid DPI Annual Meeting, with “Inspiring Polymers” as central theme. More than 130 participants, the majority online, attended the meeting.

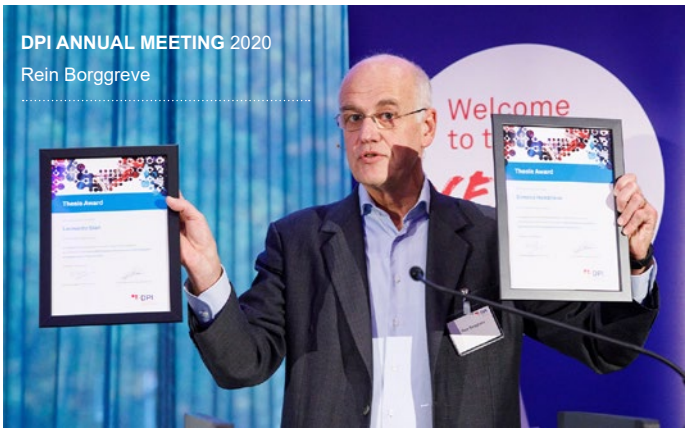
Jacques Joosten, former DPI Managing Director and current Chair of the DPI Supervisory Board, chaired the meeting at the venue. Our new Managing Director Ernst Jan van Klinken attended online and presented himself and the updated DPI strategy. He also thanked Vincenzo Busico for the many years of service as Scientific Chair of the DPI Polyolefins Programme and welcomed Bernhard Rieger (Chair of Macromolecular Chemistry TU Munich) as Vincenzo’s successor.

DPI ANNUAL MEETING 2020
Jacques Joosten

The presentation of Ernst Jan van Klinken was followed by the DPI Golden Thesis Award 2020. Three nominees presented their work in a 10-minute presentation: Leonardo Sian and Simone Hendikse online and Hanne van der Kooij live at the venue, the Van der Valk Hotel Eindhoven. After the presentations the jury consisting of Rein Borggreve (Chair, former VP Research & Technology DSM Engineering Materials), Costantino Creton (Scientific Chair DPI Performance Polymers & VP Research of ESPCI Paris) and Vincenzo Busico, unanimously granted the award to the winner: Hanne van der Kooij for her work in the thesis “Let there be light: quantitative imaging of nanoscale dynamics in polymer materials”.

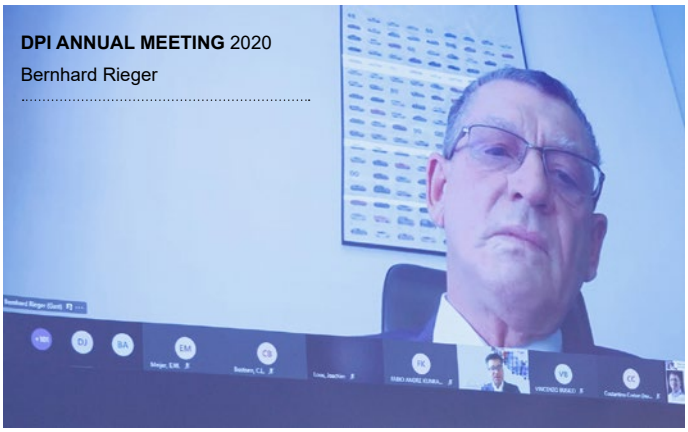
DPI ANNUAL MEETING 2020
Ernst Jan van Klinken

After the coffee break High Performance Mastermind Paul Rulkens gave us tips and tricks on “how the best get better” and Bernhard Rieger inspired us all with the keynote lecture about Inspiring Polymers.

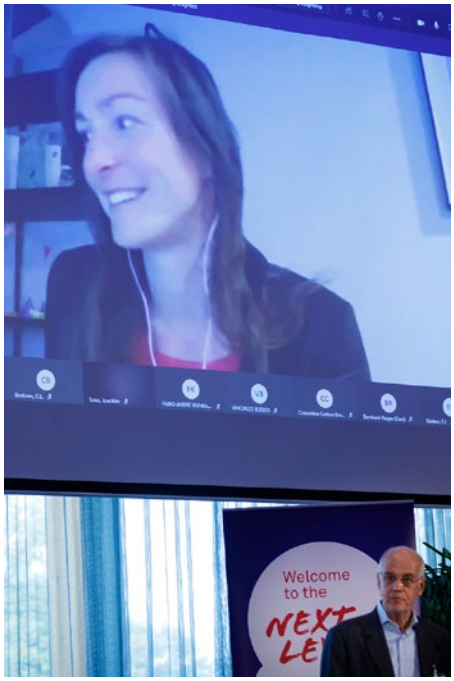


DPI ANNUAL MEETING 2020
Rein Borggreve

DPI ANNUAL MEETING 2020
Paul Rulkens



DPI ANNUAL MEETING 2020
Bernhard Rieger



DPI GOLDEN THESIS AWARD 2020
Nominees Leonardo Sian and Simone Hendikse and winner Hanne van der Kooij

POLYOLEFINS

The Polyolefins research programme encompasses the entire spectrum of the knowledge chain. The aim is to create the knowledge base needed to support the ever-expanding range of applications.

Polyolefin-based materials can be customised for many different applications: from ultra-rigid thermoplastics to high-performance elastomers. This wide performance scope is achieved through a variety of polyolefin molecular structures, whose common features are high atom economy in their synthesis, low cost, excellent properties, a long life cycle and ease of recycling.

The programme focuses on deepening of understanding of polyolefin catalysis, reaction engineering, processing and material properties and the development of new methods and methodologies to support the ongoing transition from empirical to fundamental understanding.

SUB-PROGRAMMES

Catalysis
Investigating, screening and developing (novel) homogeneous and heterogeneous catalyst systems, as well as new approaches for the immobilisation of molecular catalysts, new co-catalysts and activators.

Polymer structure, properties and processing
Understanding, modelling and predicting structure-processing property relationships in polyolefin-based polymer systems.

Polymer reactor engineering
Studying various reactor and technology unit operations to develop a quantitative description and acquire a thorough understanding of the crucial aspects of olefin polymerisation processes.

New methods and exploratory research
New polymerisation and polymer characterisation methods, high-throughput screening and experimentation, embryonic research and concept development.

FACTS AND FIGURES

Partners from industry
- Borealis
- Braskem
- Dow Benelux
- ExxonMobil
- Reliance
- SABIC
- SCG Chemicals
- SIBUR
- Sinopec

Partners from the research world
- CPE Lyon
- Eindhoven University of Technology
- Ghent University
- Japan Advanced Institute of Science and Technology
- Leibniz-Institut für Polymerforschung Dresden
- Lomonosov Moscow State University
- National Technical University of Athens
- University of Chemistry and Technology Praque
- University of Groningen
- University of Naples Federico II
- University of Perugia
- University of Turin
- University of Winconsin-Madison
- Utrecht University

Budget and organisation
Expenditure in 2020 totalled € 1.53 million. The total number of FTEs allocated at year-end 2020 was 20.7 (30 researchers). Prof. dr. Vincenzo Busico and Prof.dr. Bernhard Rieger were Scientific Chairmen and Dr. Claude Bostoen was Programme Area Coordinator of the Polyolefins programme.

Publications and inventions
This programme area generated a total of seventeen reviewed papers and one thesis. One invention was reported.

For details, see page 20

PERFORMANCE POLYMERS

Performance Polymers possess superior chemical, mechanical and physical properties, especially beyond ambient conditions. They are usually used as multi-component polymeric systems consisting of various polymers, reinforcements and additives.

The research focus of the Programme Area Performance Polymers is to enhance the performance of different polymeric systems by combining chemistry, physics and engineering science. This leads to a better understanding of the “structure versus performance” relationship on all length scales – from molecular to macroscopic.

Via the generated knowledge, the Performance Polymers programme provides opportunities for responding to the new sustainability challenges posed to the industrial sectors of automotive, aerospace, electronics, oil & gas transport and construction.

SUB-PROGRAMMES

Polymer and network chemistry and modification
Studies aimed at expanding the use of bio-based materials, by identifying their unique properties and reducing their eco-footprint. Further studies are designed to reduce the costs and energy use in polymerisation. Other objectives are network formation and the development of new concepts for monomer polymer molecular structure to achieve gradual changes in the balance of flow properties, static and dynamic mechanical behaviour and other functional properties.

Processing for properties, polymer physics and modelling
Understanding the relationship between the molecular structure, processing and properties of polymers. Studies of the processing effects of intermolecular interactions, e.g. hydrogen bonding. Processing, modification and vulcanisation studies of elastomer blends. Studies of complex flow behaviour, e.g. in particle reinforced visco-elastic materials.

Advanced reinforced thermoplastics and synthetic fibres
Studies of the interface effects in fibre-reinforced composite systems, the effects of nano-reinforcement on polymer material properties on macroscopic and microscopic scale with a focus on the effects at the matrix-filler interface, friction and wear studies of fibre-reinforced thermoplastics and elastomers.

FACTS AND FIGURES

Partners from industry
- DSM
- Hutchinson
- Kingfa
- SABIC
- Saudi Aramco
- Shell
- SKF
- Teijin Aramid

Partners from the research world
- Delft University of Technology
- École Supérieure de Physique et de Chimie Industrielles (ESPCI)
- Eindhoven University of Technology
- Ghent University
- IFREMER L'Institut Francais de Recherche et d'Exploitation de la Mer
- National Technical University of Athens
- Polymer Competence Center Leoben
- Radboud University
- The University of Manchester
- University of Bologna
- University of Nottingham
- University of Oxford
- University of Savoie Mont Blanc
- University of Twente

Budget and organisation
Expenditure in 2020 totalled € 1.07 million. The total number of FTEs allocated at year-end 2020 was 18.2 (22 researchers). Prof.dr. Costantino Creton was Scientific Chairman and Dr. Denka Hristova-Bogaerds was Programme Area Coordinator of the Performance Polymers programme.

Publications and inventions
This programme area generated a total of sixteen reviewed papers and one thesis.

For details, see page 21

POLYMERS FOR OIL AND GAS

Polymers find broad application in the recovery, transport and utilisation of oil and gas, e.g. as oil field chemicals or as light-weight materials with superior durability properties. The aim of the Polymers for Oil and Gas programme is to generate tools and new insights into existing and new polymers for utilisation in the exploration, production and transport of oil and gas.

Two main areas of study are distinguished: firstly, the use of polymers in fluids for enhanced oil recovery (EOR) and other sub surface drilling/recovery applications. Secondly, the behaviour of polymers in functional materials used under extreme/adverse conditions (in close collaboration with the Performance Polymers programme area).

SUB-PROGRAMMES

Structure-property relationships and the design of new model macromolecules
Controlled radical polymerisation techniques will be employed to investigate the effects of macromolecular topology, for example branching, on polymer solution properties and on viscosity and/or visco-elasticity. These novel structures are evaluated in core flow experiments to determine their injectivity and impact on the recovery of oil in porous media. The effects of polymeric surfactants, i.e. high molecular weight amphiphilic structures that have the potential to decrease the interfacial tension and enhance oil recovery compared with that obtained with the current polymer flooding applications, are also being investigated.

Relating polymer rheology to apparent viscosity in porous media
The objective of this sub-programme is to develop reliable models to predict the relationship of polymer-apparent viscosity in porous media to porous-medium properties, bulk rheological parameters and superficial velocity in the medium and establish the relationship with enhanced oil recovery.

FACTS AND FIGURES

Partners from the research world
- Clausthal University of Technology
- University of Bordeaux
- University of Groningen
- University of Twente

Budget and organisation
Expenditure in 2020 totalled € 0.26 million. The total number of FTEs allocated at year-end 2020 was 3.7 (4 researchers).
Dr. Jan Stamhuis and Ronald Korstanje acted as Programme Area Coordinators of the Polymers for Oil and Gas programme.

For details, see page 22

Output 2020

POLYOLEFINS

Projects

#801: Predictive modelling of mechanical anisotropy in oriented semi-crystalline polymers directly from morphological characteristics

#802: Structure determination at the nanoscale and atomic dynamics of MgCl2 primary particles in Ziegler-Natta catalysts

#803: HEat Management in Polymerization Reactors (HEMPR)

#804: From homogeneous to “colloidal” olefin polymerization catalysts: effects of mass transport limitations on reaction kinetics and polymer microstructure

#810: Online Polyolefin structuring during Cast Film Extrusion

#813: Multi-scale investigation of silica-supported ethylene polymerization catalysts during the early stages of the reaction

#814: Control of crystallisation, chain entanglement and rheology via process conditions

#815: Augment the macroscopic PROperties of i-PP composites by controlling the microscopic Fiber-matrix Interactions via Transcrystallization

#816: Correlation between process-induced crystallization and mechanical properties in injection molded isotactic polypropylene (iPP)

#817: An inter-disciplinary high-throughput approach to olefin block copolymers

#830: Electrostatic charging of polyolefin powders on the level of particles

#831: Molecular modelling of stretch-induced crystallization in polyethylene and polypropylene layers

#832: Quality model for COntaminated Recycled Polyolefins

#834: RHEOlogical determination of POLyolefin ARchitectures

#835: Quantitative Structure-Activity Relationships (QSAR) in Post-Metallocene-Based Olefin Polymerizations Using Chemically Meaningful Computational Descriptors

#836: Practical, High Throughput Quench Labeling Techniques for Information-Rich Analysis of Alkene Polymerization Catalysts

#919: Structure-Activity-Polymer Property Studies on a Novel Ziegler-Natta Olefin Polymerization Model System

Thesis

Leonardo Sian
NMR Studies on Metallocene Ion Pairs Relevant to Catalytic Olefin Polymerization

Scientific publications

A. Piovano, J. Zarupski and E. Groppo
Disclosing the Interaction between Carbon Monoxide and Alkylated Ti3+ Species: a Direct Insight into Ziegler-Natta Catalysis
Journal of Physical Chemistry Letters 11 (14) 5632-5637

A. Piovano, M. D'Amore, T. Wada, P.C. Bruzzese, G. Takasao, A. Thakur, P. Chammingkwan, M. Terano, B. Civalleri, S. Bordiga, T. Taniike and E. Groppo
Revisiting the identity of delta-MgCl2: Part II. Morphology and exposed surfaces studied by vibrational spectroscopies and DFT calculation
Journal of Catalysis 387 1-11

C. Ehm, A. Mingione, A. Vittoria, F. Zaccaria, R. Cipullo and V. Busico
High-Throughput Experimentation in Olefin Polymerization Catalysis: Facing the Challenges of Miniaturization
Industrial & Engineering Chemistry Research 59 (31) 13940-13947

C. Ehm, A. Vittoria, G.P. Goryunov, V.V. Izmer, D.S. Kononovich, O.V. Samsonov, P.H.M. Budzelaar, A.Z. Voskoboynikov, V. Busico, D.V. Uborsky and R. Cipullo
On the limits of tuning comonomer affinity of 'Spaleck-type'ansa-zirconocenes in ethene/1-hexene copolymerization: a high-throughput experimentation/QSAR approach
Dalton Transactions 49 (29) 10162-10172

C. Ehm, A. Vittoria, G.P. Goryunov, V.V. Izmer, D.S. Kononovich, O.V. Samsonov, R. Di Girolamo, P.H.M. Budzelaar, A.Z. Voskoboynikov, V. Busico, D.V. Uborsky and R. Cipullo
An Integrated High Throughput Experimentation/ Predictive QSAR Modeling Approach to ansa-Zirconocene Catalysts for Isotactic Polypropylene
Polymers 12 (5)

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Reported invention

#817: Multicapillaries microrheometer for fast and reliable fluid characterization

PERFORMANCE POLYMERS

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#805: Probing interfacial damage in composites with mechanofluorescence

#806: 2D Material Coatings for Fibres

#811: Reliable Prediction of Residual Structural Integrity and Damage- Evolution During Long-Term Fatigue in Thermoplastic Composites

#812: Physics-based fatigue design tool for matrix cracking and delamination in unidirectional and sandwich composites under multi-axial fatigue loads with arbitrary R-ratio: development, validation and finite element implementation

#819: Controlling electrical percolation in hybrid thermoplastic composites through informed selection of fillers

#822: Processing for enhandced product performance

#823: Modular, designer polydopomine adhesives for facile and versatile surface conjugation of function of polyethylenes

#824: Micromechanical modelling of complex composite systems for improved failure prediction and product design

#825: Development of Hyperpolarized and 1H MAS NMR Spectroscopy for the study of performance polymers

#826: Multi-layered wEar-Resistant Coatings with additional fUnctionality – new stRategies for enhancIng the tribologicAl performance of poLymers in demanding environments

#827: Impact Modelling of Polymers: high-Rate Experiments for Solid-state Simulations

#828: Elastomer DEgradation under MEchanical Loading: investigation of coupling effect

#829: Physical and chEmical Ageing of amoRphous polymers by moLecular simulation

#838: Supramolecular modulation of the network connectivity in vitrimers

#844: Modelling and Design of Multiphase Polymeric Materials for High Performance Applications Across Multiple Scales

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Thesis

Tarek Kershah
Thermo-mechanical and anisotropic response of polymers in contact

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Composite Structures 235

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H. Ahmadi, M. Hajikazemi and W. Van Paepegem
Closed-form formulae for prediction of homogenized ply-properties and laminate thermo-elastic constants in symmetric laminates containing ply cracks in multiple orientations
Composite Structures 241

I. Miskdjian, M. Hajikazemi and W. Van Paepegem
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Composites Science and Technology 200

K. Grigoriadi, M. Wubbenhorst, L.C.A. van Breemen, T. Putzeys, A. Gennaro, P.D. Anderson and M. Hutter
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M. Hajikazemi, L.N. McCartney, H. Ahmadi and W. Van Paepegem
Variational analysis of cracking in general composite laminates subject to triaxial and bending loads
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M.T.J.J.M. Punter, H.M. Wyss and B.M. Mulder
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COATINGS TECHNOLOGY

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Thesis

Hanne van der Kooij
Let there be light: quantitative imaging of nanoscale dynamics in polymer materials

POLYMERS FOR OIL AND GAS

Projects

#807: Smart brines for minimal surface adsorption in polymer EOR

#808: Adsorption/retention of Polymer in Porous Media

#818: Experimental and Numerical Evaluation of Polymer Viscoelasticity Effects during EOR Applications

#821: New Polymeric Surfactants for Enhanced Oil Recovery

NEWPOL

Projects

#731.015.502: Responsive Commodity Polymers

#731.015.504: Self-Synthesizing Hydrogels

#731.015.505: Supramolecular Biomaterials with Antimicrobial and Regenerative Activity

#731.015.506: Towards flexible memories with coordination polymers with polar rotors

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Rob Verpaalen
Stimuli-Responsive Commodity Polymers

DPI ...

DPI is a foundation funded by Dutch industry, universities and the government which was set up to perform exploratory research in the area of polymer materials.

DPI operates at the interface of universities and industry, linking the scientific skills of university research groups to the industrial need for innovation.

DPI carries out pre-competitive research projects to add value to the scientific community through scientific publications and to the industrial community through the creation of intellectual property.

DPI provides a unique platform for generating awareness of new technology, in which participating industrial companies, competitors in the market place, communicate on a pre-competitive basis to trigger innovation.

DPI integrates the scientific disciplines and know-how of universities into the ‘chain of knowledge’ needed to optimise the conditions for making breakthrough inventions and triggering industrial innovation.

DPI aims to combine scientific excellence with a genuinely innovative impact in industry, thereby creating a new mindset in both industrial and academic research.

DPI aims to fill the innovation gap between industry and universities and so resolve the Dutch Paradox of scientific excellence and lack of innovation.

Some 60 researchers (PhDs and Post-Docs) are currently involved in DPI projects at knowledge institutes throughout the world.

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