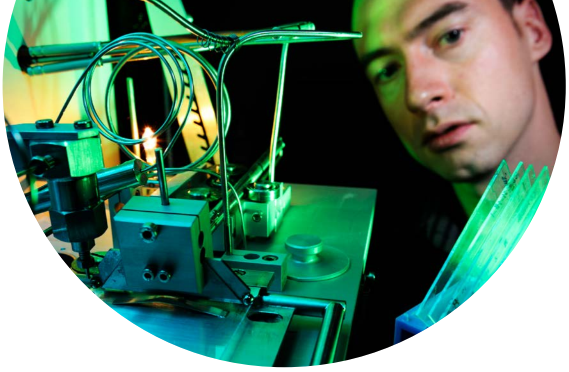


DPI

Annual Report 2022

Content

Organisation 2022

Supervisory Board

- **Dr. Jacques Joosten**
  Chair - until May
- **Dr. Herman van Wechem**
  Chair - from June until December
- **Prof.dr. Frank. Baaijens** (left in 2022)
- **Anton van Beek, MSc**
- **Bernie van Leeuwen, MSc**
- **Dr. Erik Van Praet**

Executive Board

- **Ernst Jan van Klinken, MSc** (left in 2022)
  Managing Director, Chair
- **Dr. Jacques Joosten**
  Managing Director, Chair a.i.
- **Vacancy**
  Scientific Director

Programme Managers and Business Development

- **Dr. Claude Bostoen**
  Polyolefins
- **Dr. Denka Hristova-Bogaerds**
  Performance Polymers
- **Pooja Jagadeesh, MSc**
  Business Development
- **Ronald Korstanje, MSc**
  Polymers for Oil and Gas
  Circular Plastics Initiative

Scientific Programme Chairs

- **Prof.dr. Costantino Creton**
  Performance Polymers
- **Prof.dr. Bernhard Rieger**
  Polyolefins

Organisation Staff

- **Leon Damen**
  Project Administration
  Finance
- **Renée Hoogers-Valken**
  Secretariat
- **Peter Kuppens AA**
  Controlling
- **Eylem van Mierlo**
  Finance
- **Rosanne Peters**
  Manager HR&O
- **Christianne Scharff-Bastiaens**
  Communications
- **Linda de Wit**
  Project Administration

Connecting the dots

DPI's IMPACT: Beyond just 25 years

With a history spanning more than 25 years, DPI is a world-renowned research organisation, that helped shape and define polymer science and innovation across the globe. As a creator of an international network between leading industries and scientists. As a pioneer of a unique approach to creating knowledge and competence in the polymer industry. And as a means to make research cost effective and efficient for all stakeholders. DPI did this, alongside pushing the boundaries of research competence and focusing on longer term solutions. Programmes under DPI, unlike corporate R&D and grant based academic research, can focus on long term innovation. Though the projects are pre-defined, they also generate momentum to take them beyond the programme's immediate objectives, and into longer term partnerships and economic applications. The fact that it has also inspired institutes based on a similar concept, in countries like Finland, Germany, Italy and Switzerland, is a testimony to its success.

However, there is a lot of criticism and lack of understanding on how the partnerships would actually work. The only way to make it work was to work at it.

Genesis

Throwback to the mid 90s. The Polymer processing and producing industry in the Netherlands is thriving. As a key contributor to the national GDP, it is larger than the electronics and steel industry. Both corporate R&D departments and knowledge institutes are investing in polymer technology and acquiring knowledge. It is here, in the midst of this decade, that Hans Weijers, former Minister of Economic Affairs, came up with an ambitious plan to set up Leading Technology Institutes (LTIs). These would make better use of promising industrial sectors in the Netherlands. When the call for proposals was sent out in 1995, DPI founders Piet Lemstra, Leen Struik and Jan Zuidam see opportunity.

From idea to reality

The founders have a virtual institute in mind. Instead of yet another institute that would focus on its own development and growth, it would focus on the science and how best to facilitate research and create solutions. The plan is ambitious. Leen Struik, "We thought of an LTI specialising in polymers. Our LTI to-be would concentrate on enhancing and expanding the existing chain of knowledge by taking industry and science out of their own bubbles and have them collaborate on new insights, knowledge and innovative applications". Having a virtual institute, as opposed to a brick-and-mortar setup and body, removes a lot of constraints. It will help make the DPI platform more international and diverse.

Building a knowledge infrastructure

On 28 April 1997, the Dutch Polymer Institute (DPI) comes into existence. With this, begins the work of setting up a knowledge infrastructure and building a community. The establishment of DPI addresses several gaps that exist. First of all, the existing imbalance between research and education, which has caused a shortage of competent polymer experts. Second, an increasing demand for competences to support the ongoing diversification process in industry. And third, the need to organise industrial research more cost-efficiently. For example, companies often worked simultaneously, in silos, on common themes in their respective corporate research programmes. It made sense that they could lower costs by conducting some research jointly.

The early years

The industry is enthusiastic. Piet Lemstra: "We have the big players on board right from the planning stage: AkzoNobel, Shell, Océ van der Grinten, DSM, Dow, Montell, GE Plastics and Philips. Others sign up as well. We set up four clusters: one for producing polymers, one for processing, one for characterisation, and one for applications. We invited scientific institutes to come up with research proposals in these areas. And when the scientific institutes are reticent, we challenge them." Leen Struik: "According to you this is an easy problem to solve; so solve it for me." And then proposals come in. The scientists from the academic world turn enthusiastic about the opportu¬nities at DPI and the first group pours their energy into it."

> "We are second-to-none in what we offer to the world of Polymer Science and Technology"

A unique approach

The DPI concept represented a unique value proposition: industrial competitors pool resources, work together in non-competitive areas, generate synergy and inspire each other. This is DPI's added value as compared to the universities. Understandingly, not all companies were comfortable with the idea of joining forces with competitors, initially.

The question of Intellectual Property Rights was addressed right away. In the initial years, DPI would create a patent portfolio based on funded projects. Future research within the model would then be (partly) funded by licence fees from the patent portfolio. Unfortunately, this approach was not sufficient to ensure the continuation of DPI.

After an intermediate period, DPI came to the current way of managing IPR. The inventing party is owner of the IP now and they must report the invention to all the industrial partners in the programme. In case of interest, the inventing party and interested entity can start their own negotiations.

Reorganisation and reset

Right on the verge of the new millennium, the market collapses. The plastics industry hits a downturn. Companies' focus moves from long-term development to ensuring immediate profits. Piet Lemstra: "People have to do their long-term research somewhere". So, DPI reorganises the system. Technology Areas (now called programmes) are set up to focus on application areas. Partners are asked to purchase research tickets. More tickets they have, the more say in a certain Technology Area. This approach works. And it appears that the initial idea - to innovate by means of interaction - still has potential. The industrial partners remain involved and government support continues. DPI grows, both at home and internationally.

Expansion of the focus areas

"The technology areas more than doubled", says Jacques Joosten, Interim Managing Director of DPI, and Managing Director since 2005. "Plastic electronics and bio-inspired and bio-based polymers also join the list. In addition to our long-term research strategy, we felt that there was a stronger need to commercialise ideas". That thought materialises into the establishment of the DPI Value Centre (from 2007 to 2017). This results-driven centre aims at developing new initiatives, and strengthening current ones, in start-up businesses, small and medium-sized enterprises, and major corporations.

Steering towards new opportunities

The direct government funding for DPI stops in 2014. It is replaced by a more general subsidy scheme based on the Top Technology Sectors policy. This new scheme is much less favourable for institutes like DPI. It has a negative bearing on both expertise and employment in the polymer sector in the Netherlands. It also results in a gradual shift towards a shorter-term, application-driven focus. Research programmes are steered towards current industry needs, with less room for long-term, generic research. Consequently, internationally oriented companies that are looking to expand, turn to countries and regions that prioritise research in traditional areas of polymer science and tech, like in Asia. On the other hand, this development also leads to opportunity for a new activity. DPI starts organising post-academic courses in some areas, especially polyolefins, for the benefit of companies who can't find college graduates with the required expertise.

Challenges

Support from the industrial partners keeps the DPI platform going. Despite the lack of public funding. However, it does bring its own challenges, that continue to impact the way DPI works.

Long term scope vs application-based projects

Since inception, exploring new areas in the common interest of industrial partners is a key DPI mandate. Following the change in funding, there is a gradual shift from ideas-driven research to more problem-oriented research, with change in scope for initiating projects. Unlike companies in Asia, for example, most of the industrial participants would define the scope of research as a few years, instead of considering the long-term goals.

Sustainability and circularity

Plastics/Polymers play a big role in challenges that society is currently facing, especially when you talk about energy transition and circular use of plastics. But there are also lots of challenges - mostly in sustainability - lying ahead. Companies face the same struggle as society: Sustainability vs cost aspect. These are questions that are imperative. In the conversion process from carbon building blocks into plastic materials with specific functionalities, circularity has become a prerequisite for success. Converters have to make choices, between petroleum-based and bio-based raw materials, for example. Or between the use of organic chemistry and electrochemistry, which plays an important role in e.g. hydrogen fuel cells.

Thanks to its strong worldwide network, DPI possesses a unique competence: knowing what industry needs and knowing what academic expertise is available and where.

The Legacy

DPI has made groundbreaking contributions to the world of polymer Science and Technology. Leveraging the collaboration between the various participants, the outcome of the projects, and activities has helped move the industry and science forward, in various areas.

Publications

In the past 25 years, DPI can account for more than 1000 research innovation projects, involving over 1500 researchers, 60 companies and 90 research institutions. There have been 2490 scientific publications, 320 PhD theses and 120 patents.

Knowledge Community

Jacques Joosten, Interim Managing Director & Managing Director, DPI, since 2005: "The most remarkable element to me is the scientific quality we have achieved." DPI has been monumental in creating and advancing polymer science expertise in Europe and beyond". Several researchers have been upskilled through various projects, by being a part of DPI, and are part of a well-regarded, active, international knowledge community. And because of the interaction with industry, it offers them lucrative career prospects.

Research Infrastructure

Projects under DPI have also led to the creation of standardised infrastructure and tooling. For example, High throughput experimentation research that focussed on methodology and technology development, resulted in development of tools that found wider application. A standardised tool kit that includes ICT tools, modelling tools and miniaturisation tools is being used in industry-related groups such as Polyolefins, Engineering Plastics and Functional Polymers.

Innovation

By leveraging the collective expertise and resources of its members, DPI has been successful in facilitating the development of new polymer materials with improved properties and the advancement of technologies for recycling plastics.

Facilitating the future

The Polymer world is transforming and so are the challenges that it faces. "Stepping into a new development phase, DPI must not only continue its work in the established programmes of precompetitive basic research, but also broaden its scope and branch out into areas that are important for tomorrow's world": Jacques Joosten. A relevant example is DPI's involvement in CPI, the recently launched Circular Plastics Initiative, for which DPI has teamed up with ISPT (Institute for Sustainable Process Technology). Together they are working on building responsible, circular value chains in plastics.

DPI had always had an international mandate and character that just grew organically, with the evolution of the industry. Being a virtual institute made it possible to involve international companies and local knowledge institutes from those countries, across the globe. "We are second-to-none in what we offer to the world of Polymer science and technology". The future sees DPI continuing in its facilitating role, connecting the industry and academia, in a bid to address both knowledge and environmental issues, and create long term impact.

"Polymer technology is a multidisciplinary profession. To innovate successfully you have to look at what others are doing."

DPI – Shaping polymer innovation

DPI fundamental research

Within the fundamental DPI programmes, the research challenges defined by the participating industrial partners are translated by DPI into scientific questions. We invite the most suitable academic groups to propose their ideas on how they can tackle those questions, until proof of concept. The industrial partners decide which ideas will receive grants for further research and they closely follow and guide the scientific output of the project.

DPI aligns the industrial interests and manages the whole process - from defining industrial needs to creating and monitoring relevant research projects. We take care of the day-to-day coordination, while the companies can concentrate their time and efforts on implementing the knowledge gained.

To cover most of the immense spectrum of polymer science, the fundamental research is divided into different programmes. Currently it comprises of the following programmes: Polyolefins, Performance Polymers and Polymers for Oil and Gas.

Pre-Competitive programme

Polyolefins	Performance Polymers	Polymers for Oil and Gas
20 projects 37 researchers	25 projects 40 researchers	4 projects 4 researchers
Industry	**Industry**	**Industry**
• Borealis • Braskem • Dow Benelux • ExxonMobil • Reliance • SABIC • SCG Chemicals • SIBUR*	• DSM • Hutchinson • Kingfa • SABIC • Saudi Aramco • Shell • SKF • Teijin Aramid	• Shell • SNF
Academia	**Academia**	**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 Konstanz • University of Naples Federico II • University of Perugia • University of Salerno • University of Turin • University of Wisconsin-Madison • Utrecht University	• Delft University of Technology • Eindhoven University of Technology • ESPCI Paris for Research and Technology - Hellas • Ghent University • IFREMER • JOANNEUM RESEARCH • KTH • Lyon 1 • Montanuniversität Leoben • National Technical University of Athens • NTNU • Polymer Competence Center Leoben • Radboud University • Shanghai Jiao Tong University • Sichuan University • Southwestern University of Finance and Economics • The University of Manchester • TPRC • University of Lincoln • University of Nottingham • University of Oxford • University of Patras • University of Twente • University Savoie Mont Blanc • Universiy of Bologna • University of Edinburgh • Vrije Universiteit Amsterdam	• Clausthal University of Technology • Delft University of Technology • University of Groningen • University of Twente

*Suspended until further notice in line with EU sanctions related to the war in Ukraine

Industrial research

The industrial research projects are initiated by DPI, outside of the DPI Fundamental Programmes. Together with industrial and research partners, DPI creates consortia to promote innovation within the value chain. The industrial research projects focus on the further advancement of an innovation and every partner plays an active role. These projects offer companies and research institutes the opportunity to form consortia and to execute innovation activities beyond the proof-of-concept level.

We actively assist in establishing the collaboration and in coordinating the projects. We provide a model framework for this process, while the detailed rules are agreed on between the members of the consortium itself.

Circular Plastics Initiative

Towards a responsible, circular value chain in plastics
We live in a 'plastic age' where society thrives thanks to developments in polymer science and technology. At the downside, plastic litter can be found all around the globe. As a society, we need to rethink plastic. It is too valuable to be treated as waste. And it can serve as the feedstock for circularity. This calls for concerted action, in particular, to tackle plastic waste and ensure its recycling.

The mission of the Circular Plastics Initiative is to boost circularity in plastics on an industrial scale. We address the entire value chain from an international perspective and focus on the technological, logistic, and societal challenges lying ahead.

Efforts to reduce the use of plastics will contribute to solving its associated problems. However, for many purposes plastics offer advantages to other materials. They often combine high performance with reduced weight and thus help reduce the use of energy. It is therefore equally important to develop a strategy for their responsible use. Circularity will have to be at the heart of this strategy.

At the Circular Plastics Initiative, we work towards a fully circular value chain, from production and use via collecting and sorting towards re-use and recycling. This is done in a concerted action involving all relevant players and addressing all relevant issues. The focus will be in particular on plastics used in food packaging, as these confront us with the most pressing problems. They are prone to irresponsible disposal, they are difficult to sort and it's quite a challenge to bring them back to the beginning of the value chain. Achieving circularity in plastics for food packaging will therefore lead the way to achieving plastics circularity in general.

The Circular Plastics Initiative is co-founded by ISPT and DPI.

Institute for
Sustainable
Process Technology

The projects focus on:

- Analysis of the composition of the mixed plastic waste stream and of contaminants therein
- Evaluation of sorting technology
- Evaluation for chemical processing (pyrolysis & gasification) in terms of quality and scalability (beyond 100 kt/a)
- Evaluation of the opportunities and pitfalls in using the pyrolysis oil as feed for plastic production

Current projects:

- Towards Improved circularity of polyolefin-based packaging
- InReP – An integrated approach towards Recycling of Plastics
- LEmPlaR- Losses & Emissions in Plastic Recycling

CPI publications in 2022:

Gerjen H. Tinneveld, Jeroen J. Jansen, Mahdiyeh Ghaffari, Nematollah Omidikia
Non-Negative Matrix Factorization and Systematic Simplification of Hyperspectral Images for High-Speed Plastic Sorting

Geert Postma, Gerjen H. Tinneveld, Jeroen J. Jansen, Mahdiyeh Ghaffari, Marcel van Eijk, Stanislav Podchezertsev
Mono / Multilayered Plastic Sorting Based on Multi-Block Non-Negative Matrix Factorization

Hero J. Heeres, Homer C. Genuino, M. Pilar Ruiz, Sascha R.A. Kersten
Pyrolysis of mixed plastic waste (DKR-350): Effect of washing pre-treatment and fate of chlorine

Hero J. Heeres, Homer C. Genuino, M. Pilar Ruiz, Sascha R.A. Kersten
Pyrolysis of mixed plastic waste: predicting the product yields

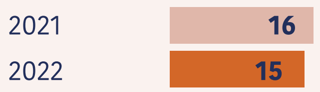
Summary of financial data 2022

Income	(x EUR million)	%
Contributions from industrial partners	2.48	70.0
Subsidy of TKI Toeslag	0.77	21.8
Industrial research	0.22	6.2
Business Development	0.07	2.0
Total income	**3.54**	**100**

Expenditure	(x EUR million)	%
By nature		
Personnel costs	4.04	80.0
Depreciation	0.01	0.2
Other costs	1.00	19.8
Total expenditure	**5.05**	**100**
By Programmes		
Polyolefins	1.43	28.3
Performance Polymers	1.72	34.1
Polymers for Oil and Gas	0.16	3.2
Organisation and support	1.11	22.0
Industrial research	0.29	5.7
Business Development	0.34	6.7
Total expenditure	**5.05**	**100**

Key Performance Indicators
DPI fundamental programmes

Number of industrial partners



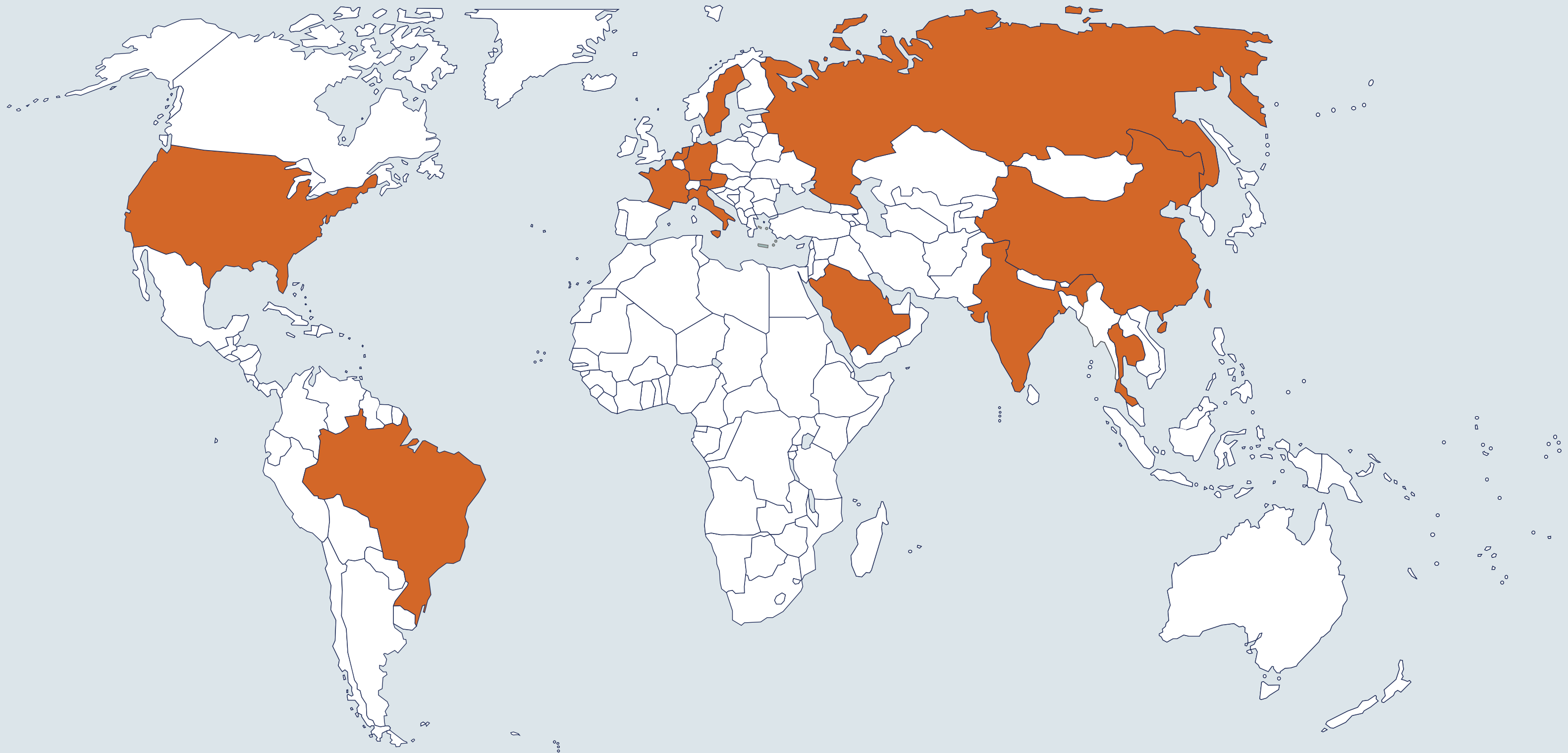
Number of partner knowledge institutes (universities, etc.)

Track record DPI researchers	
Left in total	16
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	5
Unknown	4

Research output	2021	2022
Scientific publications	30	25
PhD theses	7	4
Average journal impact factor	5.09	5.47

Partners industry 2022

involved in DPI fundamental programmes



Europe

- Borealis
- Hutchinson
- SIBUR*
- SKF
- SNF Floerger

The Netherlands

- Dow Benelux
- DSM
- SABIC
- Shell
- Teijin Aramid

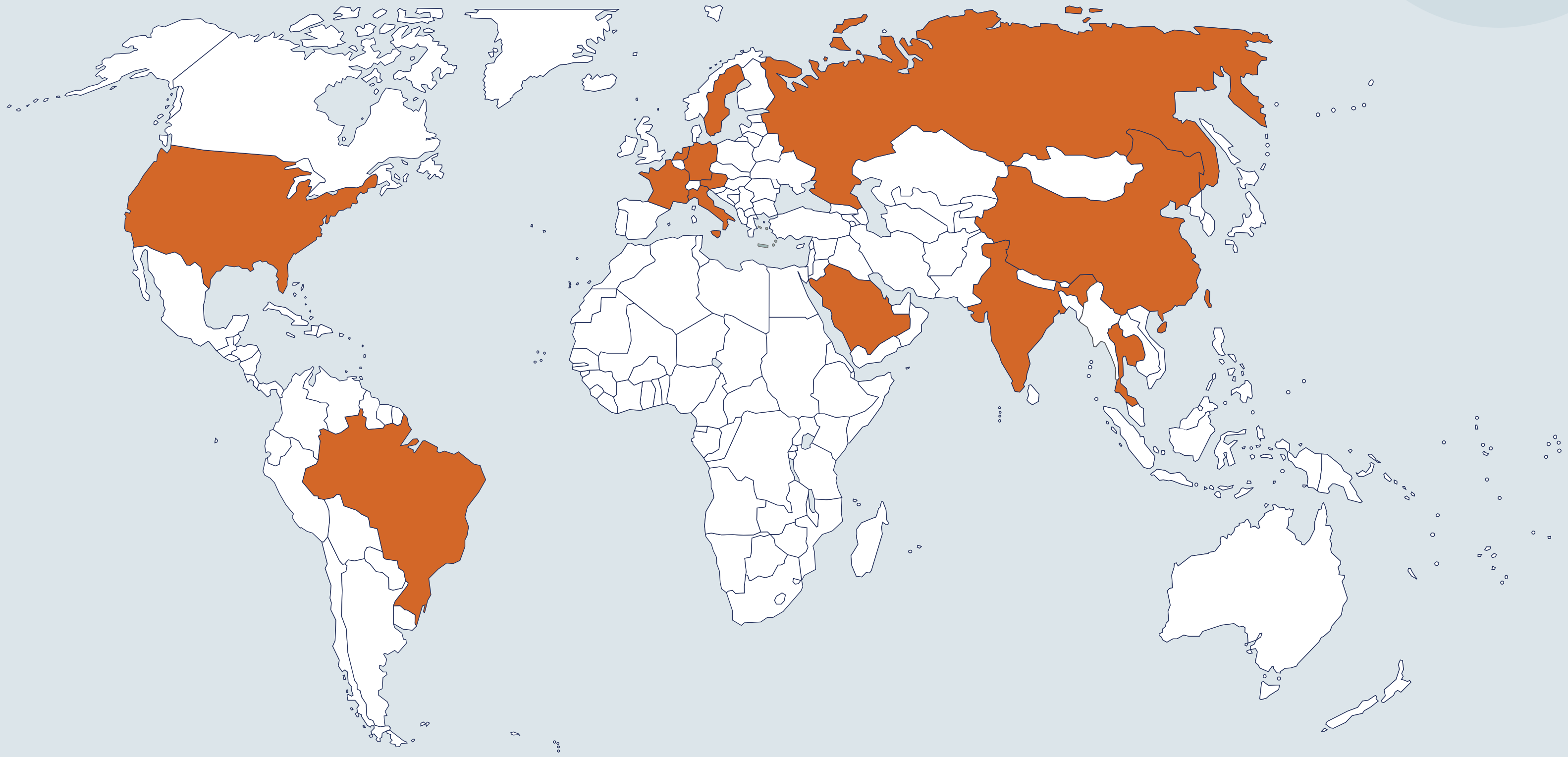
North and South America, Asia

- Braskem
- ExxonMobil
- Kingfa
- Reliance
- Saudi Aramco
- SCG Chemicals

*Suspended until further notice in line with EU sanctions related to the war in Ukraine

Partners knowledge institutes 2022

involved in DPI fundamental programmes



Europe

- Clausthal University of Technology
- CPE Lyon
- ESPCI Paris
- Foundation for Research and Technology - Hellas
- Ghent University
- IFREMER
- JOANNEUM RESEARCH
- KTH
- Leibniz-Institut für Polymerforschung Dresden
- Lomonosov Moscow State University*
- Lyon 1 (new in 2022)
- Montanuniversität Leoben
- National Technical University of Athens
- NTNU (new in 2022)
- Polymer Competence Center Leoben
- The University of Manchester
- University of Bologna
- University of Chemistry and Technology Prague
- University of Edinburgh (new in 2022)
- University of Konstanz
- University of Naples Federico II
- University of Nottingham
- University of Oxford
- University of Patras
- University of Perugia
- University of Salerno
- University of Turin
- University Savoie Mont Blanc

The Netherlands

- Delft University of Technology
- Eindhoven University of Technology
- Maastricht University
- Radboud University
- TPRC (new in 2022)
- University of Groningen
- University of Twente
- Utrecht University
- Vrije Universiteit Amsterdam (new in 2022)

North and South America, Asia

- Japan Advanced Institute of Science and Technology
- Shanghai Jiao Tong University
- Sichuan University
- Southwestern University of Finance and Economics
- University of Lincoln (new in 2022)
- University of Wisconsin-Madison

*Suspended until further notice in line with EU sanctions related to the war in Ukraine

25 year anniversary - PolymeRevolution

DPI reinvented for a bright future

Marking the 25th anniversary of DPI, many of those involved with the institute gathered for the meeting in Eindhoven. "Why?", asked moderator Simone van Trier. To catch up, to see who's here, to enlarge and deepen networks and to hear about new research projects. Co-host Rein Borggreve added: Polymers play a key role in the challenges we face, including the energy transition and sustainability. Polymer science is key." The speakers that Van Trier and Borggreve hosted presented an overview of 25 years DPI and a glimpse of what the future will bring.

DPI managing director ad interim Jacques Joosten introduced himself as the prototype of circularity: "I am the successor of my successor," he smiled. The 25th anniversary comes at a historically very interesting moment, he said. "DPI has come a long way. We are still here and there is a future for us." Joosten continued to first show the audience the successful first phase of DPI starting in 1997, followed by the reason why it is relevant to mention that DPI is still here. The Dutch government launched a 'new innovation policy' in 2011, which was nothing more than an austerity measure, said Joosten. "Instead of two-thirds funding from the government and one-third from industry, we had to reverse those numbers." In short, DPI managed to bridge the gap and can look back at more than 1000 research innovation projects, involving over 1500 reserachers, 60 companies and 90 research institutions. New challenges include recycling, fundamental understanding and finding new money to let DPI grow.

Product development versus fashionable research

An important and large programme within DPI is Performance Polymers (PP), which focuses more on properties than synthesis, said Costantino Creton (ESPCI Paris and scientific chair Performance Polymers of DPI). "We need to find a middle ground to convince academics to work on an area that is not so fashionable but relevant, and to industry to trust academia to work on long range topics. There is room for projects that are not well funded by public money but relevant for industry and interesting for academics." There is an evolution of the main objectives in PP, observed Creton, from new materials and understanding fundamental properties and processing to a focus on recycling, reprocessing and recovery, and lifetime prediction.

Organiser of the playground

Vincenzo Busico (Federico II University of Naples, Italy) sees an essential enabling role for DPI. "For me, DPI is a very nice playground for a game that is called 'polyolefins science and technology'. You cannot play a good match if the field is not well prepared." Busico gave the audience an amusing as well as slightly confronting insight in the early organisation of DPI when he started as a Polyolefin scientific chair. "It was a brilliant idea, high quality science on industrially relevant topics, very little bureaucracy, few constraints, adequate funding, and ... freedom, freedom, freedom. Very much Dutch," Busico said. "Some more coordination wouldn't have harmed, though". On a more serious note, he stated that allocating public funds on industrial R&D projects in mature fields is not justified:

"Industry should realise that if they want fundamental and pre-competitive polyolefin science to stay alive and grow new generations of talented researchers to secure their own future, they should pay the bill. And DPI is the perfect environment for that."

The carbon transition

Rolf van Benthem (chief scientist materials science - polymers at Shell) showed a holistic view on sustainable polymers from the perspective of Shell. The energy transition is associated by a carbon transition. In 2050, our energy comes from renewable resources. The question is: where do our materials come from? From three options, Van Benthem showed that only recycling can play a major role in 2050. Biobased materials can only partially supply the needed carbon and the technology to re-use CO_2 will not play a major role before 2050.

Finally, Just Jansz briefly updated on the status of Circular Plastics NL, a growth fund co-funded by industry and other stakeholders. The €220M fund has been approved and the announcement of calls is expected for 2023. "We will definitely work with DPI to make use of their expertise on starting such a programme."

The industrial perspective

Seen from the perspective of industry, polymer science has a lot to offer. An impressive selection of companies involved in DPI over the years showed the audience their view on the collaboration. Krijn Dijkstra, vice president research and technology at DSM said: "Materials science doesn't appear by magic. It's hard work and requires continuous investments in academic networks and alignment with academia. For DSM, DPI is essential as we don't have the scale." Sustainability is an 'industry mega trend' said Dijkstra. He added that: "Digitisation is a major change in the way we do research. Our markets need much faster answers and you can't deliver that with the classical way of working."

Solving major challenges

Markus Gahleitner (senior group expert, Borealis) also elaborated on the well-known worldwide challenges, such as sustainability, circularity, nutrition, energy and health for a growing population. "Polyolefins can and should play a major role in solving these," said Gahleitner. Examples how to do this include combating food waste with better packaging, developing essential elements for solar and wind energy and develop medical products such as antiviral face masks. "Industry must act but academia should support by suggesting action," advised Gahleitner.

New requirements for electric vehicles

Laurent Gervat, managing the upstream strategy material team, and polymer expert at Renault, showed that the electrification of mobility presents materials challenge for the automotive industry as well. For electric vehicles, there are new requirements, regulations and specifications being developed. This includes materials fire resistance and protection, durability including thermal shock endurance, high purity plastics for fuel cells and recycled and decarbonated plastics. "We ask you to contribute to find better batteries, make batteries safer, improve vehicle durability and improve sustainability," requests Gervat

Accelerating through value chain collaboration

"As a brand owner, Unilever is in a unique position to accelerate the transition and have significant impact", said Thor Tummers (External Affairs Unilever). "We can drive the transition towards a circular economy for plastic packaging through partnership across the value chain and using the power of brands. We have to make the choice for consumers very easy and communicate facts and choices around sustainability." Tummers calls for collaboration, both between industry and academia, and - increasingly important - with governments, investors and societal- and environmental organisations, to create an enabling legal framework, stimulating investments and create broad societal support. "Jointly developing new sustainable solutions based on feasibility, scalability, innovativeness and partnerships. If we tick all those boxes - and I strongly believe this is the case with DPI and its partners - new solutions will arise."

A window to the polymer world

For Teijin Aramid, DPI has clear value, said Pieter de Lange (Principal Scientist Product & Application Development). The first is the scientific outcome of the programmes. Examples are development of new adhesion systems to improve bonding between aramid fibers and rubber. "This is high risk research and no commercial breakthroughs were made. But we acquired a lot of knowledge," said De Lange. Additionally, DPI offers Teijin Aramid a window to the 'outside polymer world' and a strong 'polymer network' with international knowledge institutes and other companies.

Beneficial relationship

Virendra Kumar Gupta, (head R&D polymer and senior vice president, Reliance Industries Ltd) shared how Reliance went through several phases to learn how DPI could be of the best benefit to the company. "Any new company joining DPI needs to define where the relation will be beneficial," he concluded. For Reliance, the research programme in ultrahigh molecular weight polyolefins brought real value. "This is a clear example where two industrial partners could work with DPI to create a new understanding of UHMW polypropylene."

Collaboration is key

ExxonMobil is highly involved in the support of plastics circularity, explained Helge Jaensch (Sustainable Product Portfolio Lead Global Chemical Research). "We believe that advanced recycling is a necessary complement to mechanical recycling. But no single player can solve the plastic waste challenge on their own. Policy support and collaboration will be key." That is where DPI but also other growth funds in The Netherlands can make a difference. "DPI plays a key role in advancing dialogue. This is necessary to help quickly address society's plastic circularity goals," Dr. Jaensch pointed out.

Reflections on 25 years with DPI

Jaap den Doelder (R&D fellow Dow Benelux) was a PhD student in 1997 when DPI was founded. Den Doelder observed: "The start was about closing the gap between public and private knowledge on polymers. It was called the Chain of knowledge, a beautiful phrase." The field was evolving in many ways, he continued: the company R&D perspective as well as the DPI structure evolved. "For Dow this has resulted in a focus on the polyolefins technology area and the plastics circularity area. In my opinion this is the key area where we should partner with companies and DPI."

Sustainability as the main focus

As the celebrations neared their end, the question is: what are we heading for within research? Rein Borggreve: "The topic of sustainability comes back again and again. We still have the same challenges to keep coming up with new material solutions, but now combined with sustainability. Slowly we are going in the right direction in sustainability. It used to be a side subject, but it is picked up now. Polymers are key. We need young people like the PhD's for this and it's our responsibility to attract them." Finally, Borggreve concludes: "We have heard about our history, we heard from companies, about the big challenges. We can all be very happy that DPI is there, and that is because of Jacques Joosten. DPI is here to stay and the future looks bright."

DPI Golden Thesis Award 2022

Prof. Rieger, chair of the jury for the DPI Golden Thesis Award introduced the award before announcing the winner: "This award is as old as the DPI. We judge it very highly and we had seven excellent dissertations this year. We evaluated these for scientific excellence, quality, originality, presentation and the role that the work may play within DPI. Next to Bernard Rieger the jury consisted of Costantino Creton and Rein Borggreve. The three nominees for the Golden Thesis award presented their work, which is scientifically very diverse but have a high quality of scientific work in common. Gaia Urciuoli won the Golden Thesis Award 2022 for her excellent research on the 'Structural characterization of olefin-based multiblock copolymers from chain shuttling technology'. Prof Rieger said: "We congratulate you Gaia and you have to promise to stay with your scientific excellency."

Unravelling complex block copolymers

Gaia Urciuoli's work focuses on analysing block copolymers made with a new technology called chain shuttling, where two types of catalysts for olefin polymerisation are mixed in order to obtain a multiblocky polymer. A chain transfer agent shuttles the growing blocks between the catalysts, creating chains of polymers with soft and hard blocks. By definition, this results in a very complex and polydisperse product. Urciuoli found a number of approaches to analyse the resulting materials. She explained: "The high-throughput method we developed but also our multidisciplinary approach allowed us to successfully explain the microstructure and different properties of these very complex systems."

Evaluating recycled plastics

Ruben Demets designed a method to evaluate complex plastic waste streams and the quality of the resulting recycled polymers. Challenges in mechanical recycling include varying properties, cross contamination, multipolymer products and presence of contaminants such as inks or volatiles. The prediction of the recycling quality is therefore important, explained Demets. Among his results are a calculation method to score the technical substitutability and functionality of recycled plastics, and methods to quantitatively measure volatiles to evaluate the removal efficiency after recycling. Using these methods, he evaluated blends, gaining insight in their altered deformation mechanisms and mechanical properties.

Responsive commodity polymers

Rob Verpaalen combined commodity polymers like nylon, PET and PE, with advanced stimuli responsive materials. These change their behaviour to a physical stimulus such as temperature, humidity, or light. By altering the properties of the high volume, low price commodity polymers, they may be suited in the field of soft robotics and smart textiles, Verpaalen showed. One of his materials included light responsive additives embedded in polyethylene. The additives convert light into heat which generates a high amount of stress in the material. This stress can be used to deform the material, similar to a robot hand.

Polyolefins

The Polyolefins research programme encompasses the entire spectrum of the knowledge chain. The aim is to create the knowledge base necessary to support an 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 range of performance is achieved due to a variety of polyolefin molecular structures that share common features of high atomic efficiency in synthesis, low cost, excellent properties, long lifetime, and easy recyclability.
The mission of this Programme is to support and coordinate integrated pre-competitive or explorative research projects, on polyolefins, along the whole knowledge chain. From (homogeneous and heterogeneous) catalyst synthesis and immobilisation, through catalytic olefin polymerisation, down to polyolefin characterisation, processing, and end-use evaluation. Care for materials and process sustainability, from the perspective of a Circular Economy, is a pervasive characteristic of the research Programme.

Focus areas

Circular Economy solutions for Polyolefins KThe
The key focus of this sub programme is on mechanical recycling and chemical recycling processes, non-chemical recycling, and non-mechanical methods of recycling, while preserving quality and purity of recyclates. The aim is to develop a new concept of recycling design especially based on polyolefins, among others, to circumvent the multi-layer complexity of PET/EVOH/PE composites. Either through polymer design or specific processing steps, with adjusting O_2/CO_2 barrier properties. Polyolefin modification based on renewable sources is another route to establishing these circular economy targets.

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.

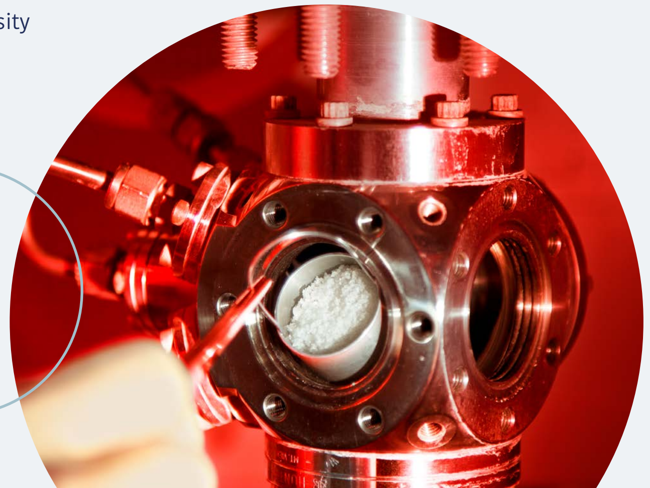
New methods and exploratory research
New polymerisation and polymer characterisation methods, high-throughput screening and experimentation, embryonic research and concept development.

Catalysis
Investigating, screening and developing (novel) homogeneous and heterogeneous "Wherever polymer technologists manipulate connections within a molecule to achieve new functions and applications, DPI is connecting polymer technologists." systems, as well as new approaches for the immobilisation of molecular catalysts, new co-catalysts and activators.

Facts and figures

Partners from industry
- Borealis
- Braskem
- Dow Benelux
- ExxonMobil
- Reliance
- SABIC
- SCG Chemicals
- SIBUR (Suspended until further notice in line with EU sanctions related to the war in Ukraine)

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 (Suspended until further notice in line with EU sanctions related to the war in Ukraine)
- Maastricht University
- National Technical University of Athens
- University of Chemistry and Technology Prague
- University of Groningen
- University of Konstanz
- University of Naples Federico II
- University of Perugia
- University of Salerno
- University of Turin
- University of Wisconsin-Madison
- Utrecht University



Budget and organisation
In 2022 there were 37 researchers (PhDs and postdocs) working within the 20 of the Polyolefins programme, 3 new projects started with a total budget of €0.7 Million. Prof.dr. Bernhard Rieger was Scientific Chair and Dr. Claude Bostoen was Programme Manager.

Publications and inventions
This programme generated 13 reviewed papers and 3 theses in 2022.

For details, see page 22

Performance Polymers

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

The research focus of the Performance Polymers Programme is on enhancing the performance of advanced polymeric systems, by combining Chemistry, Physics and Engineering Science, using state-of-the art modelling and characterisation tools. This leads to a better understanding and predicting of the "structure versus performance" relation and of the lifetime of the performance polymers, and contributes to the design of new/improved performance materials of the future.

The knowledge generated through this programme provides opportunities for responding to the new sustainability challenges. Especially for the automotive, aerospace, electronics, oil & gas transport, energy and construction industrial sectors.

Focus areas

Advanced modelling & experimental strategies for enhanced durability & performance
- Surface treatment for enhanced polymer performance
- Composites fatigue: prediction of damage and correlation to lifetime
- Impact mechanisms in polymer composites
- Extending durability / lifetime of performance polymers
- Advances in solid-state NMR for polymeric systems

Processing – Structure – Performance relationship
- Flow instability and processing of filled polymeric melts
- Linking rheology to the molecular and macroscopic structure of polymers

Polymers for electronics and energy storage/ transportation
- Informed design of electrically conductible composites
- Polymers and composites under high voltage conditions
- Polymers as high-barrier materials for gas (H2) storage/ transportation
- Polymers for solid state batteries

Recycling / Reprocessing / Recovery of performance polymers
- Reversible bonds for re-use/recycling of composites and thermosets
- Composites recycling / re-processing

Alternative resources for performance polymers
- Bio-based polyamides
- CO_2 derived polymers

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
- Eindhoven University of Technology
- ESPCI Paris
- Foundation for Research and Technology - Hellas
- Ghent University
- IFREMER
- JOANNEUM RESEARCH
- KTH
- Lyon 1
- Montanuniversität Leoben
- National Technical University of Athens
- NTNU
- Polymer Competence Center Leoben
- Radboud University
- Shanghai Jiao Tong University
- Sichuan University
- Southwestern University of Finance and Economics
- The University of Manchester
- TPRC
- University of Lincoln
- University of Nottingham
- University of Oxford
- University of Patras
- University of Twente
- University Savoie Mont Blanc
- Universiy of Bologna
- University of Edinburgh
- Vrije Universiteit Amsterdam

Budget and organisation

In 2022 there were 40 researchers (PhDs and postdocs) working within the 25 projects of the Performance Polymers programme, 4 new projects started with a total budget of €1.1 Million.

Prof.dr. Costantino Creton was Scientific Chair and Dr. Denka Hristova-Bogaerds was Programme Manager of the Performance Polymers programme.

Publications

This programme generated 11 reviewed papers and one thesis in 2022.

For details, see page 24

Polymers for oil and gas

PPolymers find broad application in the recovery, transport and utilisation of oil and gas. For example, as oil field chemicals or as lightweight materials with superior durability properties. The Polymers for Oil and Gas programme aims to generate tools and new insights into existing and new polymers, for utilisation in the exploration, production and transport of oil and gas. The focus is on two main areas of study. The first is the use of polymers in fluids for enhanced oil recovery (EOR) and other sub surface drilling/recovery applications. Second, polymer behaviour in functional materials used under extreme/adverse conditions (in close collaboration with the Performance Polymers programme).

Focus areas

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, are also being investigated. These may yield better results compared to those obtained with the current polymer flooding applications.

Relating polymer rheology to apparent viscosity in porous media

Developing 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 industry

- Shell
- SNF

Partners from the research world

- Clausthal University of Technology
- Delft University of Technology
- University of Groningen
- University of Twente

Budget and organisation

In 2022 there were 4 researchers (PhDs and postdocs) working within 4 projects of the Polymers for oil and gas programme. Ronald Korstanje acted as Programme Manager.

Publications and inventions

This programme generated 1 master thesis in 2022.

For details see page 25

Output

Polyolefins

Projects

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

#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

#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

#846: In-Chain Functionalized Polyethylenes from Controlled Free-Radical Polymerization under Benign Conditions

#847: A microstructural insight in polyethylene based bioriented mono-materials: from fundamental to processing

#848: Ziegler-Natta Catalysts for Polypropylene with Temperature-Controlled ID/ED Compositions

#855: Governing Sparsely Long Chain Branching in Polyolefins by rheology: a milligram size approach (new in 2022)

#856: Multi-scale Analysis and Design of the Pyrolysis of Polyolefins (new in 2022)

#857: Innovative Molecular Activators for Olefin Polymerization (new in 2022)

Theses

Ruben Demets
The assessment of quality and substitution potential of recycled plastics

Roberta Lopes do Rosario
Disentangled UHMWPE - Control of crystallization, chain entanglement and rheology via process conditions

Maximilian Werny
Probing the Morphology, Composition and Temperature of Olefin Polymerization Catalyst Particles with Microscopy and Spectroscopy

Publications

A. Vittoria, G. Urciuoli, S. Costanzo, D. Tammaro, F.D. Cannavacciuolo, R. Pasquino, R. Cipullo, F. Auriemma, N. Grizzuti, P.L. Maffettone and V. Busico
Extending the High-Throughput Experimentation (HTE) Approach to Catalytic Olefin Polymerizations: From Catalysts to Materials
Macromolecules 55 (12) 5017-5026

D.M. Balice, C.W.C. Molenaar, M. Fochesato, C.M. Venier, I. Roghair, N.G. Deen and M.V. Annaland
CFD modeling of droplet permeability in fluidized beds
International Journal of Multiphase Flow 152

E. Milacic, M.N. Manzano, S. Madanikashani, G.J. Heynderickx, K.M. Van Geem, M.W. Baltussen and J.A.M. Kuipers
Liquid injection in a fluidised bed: Temperature uniformity
Chemical Engineering Science 256

F. Di Sacco, L. de Jong, T. Pelas and G. Portale
Confined crystallization and polymorphism in iPP thin films
Polymer 255

G. Antinucci, B. Dereli, A. Vittoria, P.H.M. Budzelaar, R. Cipullo, G.P. Goryunov, P.S. Kulyabin, D.V. Uborsky, L. Cavallo, C. Ehm, A.Z. Voskoboynikov and V. Busico
Selection of Low-Dimensional 3-D Geometric Descriptors for Accurate Enantioselectivity Prediction
Acs Catalysis 12 (12) 6934-6945

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Thermal Fractionation of Ethylene/1-Octene Multiblock Copolymers from Chain Shuttling Polymerization
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L. Sian, A. Dall’Anese, A. Macchioni, L. Tensi, V. Busico, R. Cipullo, G.P. Goryunov, D. Uborsky, A.Z. Voskoboynikov, C. Ehm, L. Rocchigiani and C. Zuccaccia
Role of Solvent Coordination on the Structure and Dynamics of ansa-Zirconocenium Ion Pairs in Aromatic Hydrocarbons
Organometallics 41 (5) 547-560

M.J. Werny, D. Muller, C. Hendriksen, R. Chan, N.H. Friederichs, C. Fella, F. Meirer and B.M. Weckhuysen
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Chemcatchem 14 (21)

M.J. Werny, K.B. Siebers, N.H. Friederichs, C. Hendriksen, F. Meirer and B.M. Weckhuysen
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Journal of the American Chemical Society 144 (46) 21287-21294

N.I. Sigalas, S.D. Anogiannakis, D.N. Theodorou and A.V. Lyulin
A coarse-grained model for capturing the helical behavior of isotactic polypropylene
Soft Matter 18 (15) 3076-3086

R. Demets, M. Grodent, K. Van Kets, S. De Meester and K. Ragaert
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Polymers 14 (2)

S.F.S.P. Looijmans, M.M.A. Spanjaards, L. Puskar, D. Cavallo, P.D. Anderson and L.C.A. van Breemen
Synergy of Fiber Surface Chemistry and Flow: Multi-Phase Transcrystallization in Fiber-Reinforced Thermoplastics
Polymers 14 (22)

T. Wada, G. Takasao, M. Terano, P. Chamniingkwan and T. Taniike
Structure Determination of the delta-$MgCl_2$ Support in Ziegler-Natta Catalysts
Journal of the Japan Petroleum Institute 65 (3) 88-96

Performance Polymers

Projects

#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

#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

#837: Linking rheological material functions to polymer crystallization

#838: Supramolecular modulation of the network connectivity in vitrimers

#839: Dynamic chemistry for tunable reversible bonding in bulk and at interfaces

#840: Engineering the rheology ANd processinG-induced structural anisotropy of poLymEr composites with non-Brownian fibrous particles

#841: Understanding the Rheological Origin of Striped Flow Marks in Injection Molding

#843: Recyclable high-performance composites with reversible interface bonding

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

#845: A joint molecular modelling and experimental approach to developing novel thin-film polymer barriers for gas containment systems

#850: Mechanism of Electrical Aging Caused by Different Structural Defects in Performance Polymer Materials

#851: Creep Fatigue Interaction in Performance Polymers at High Temperatures

#852: Thermo-electrical ageing mechanisms in polymer-ceramic nanocomposites for energy storage applications (new in 2022)

#853: PA/Glass fiber recycling by reactive extrusion (new in 2022)

#854: Monitoring lifetime of thermoplastic composites by combining analytics and machine learning (new in 2022)

#859: Quantum-Chemical Life-Time Optimization of Sustainable Engineering Polymers (new in 2022)

#860: OptimiseD matrix and fIbre treatmeNt for high performance thermoplastic composites recycling (new in 2022)

Theses

Annelore Aerts
Mechanofluorescent Visualization of Stresses in Polymers and Composites

Publications

A.R. Trivedi, P.H. Song and C.R. Siviour
Experimentally simulating adiabatic behaviour: Capturing the high strain rate compressive response of polymers using low strain rate experiments with programmed temperature profiles
Polymer Testing 116

D. Kovacevic and F.P. van der Meer
Strain-rate based arclength model for nonlinear microscale analysis of unidirectional composites under off-axis loading
International Journal of Solids and Structures 250

D. Kovacevic, B.K. Sundararajan and F.P. van der Meer
Microscale modeling of rate-dependent failure in thermoplastic composites under off-axis loading
Engineering Fracture Mechanics 276

E. Rashidinejad, H. Ahmadi, M. Hajikazemi and W. Van Paepegem
Closed-form analytical solutions for predicting stress transfers and thermo-elastic properties of short fiber composites
Mechanics of Advanced Materials and Structures

G.G. Vogiatzis, L.C.A. van Breemen and M. Hutter
Response of Elementary Structural Transitions in Glassy Atactic Polystyrene to Temperature and Deformation
Journal of Physical Chemistry B 126 (39) 7731-7744

H. Ahmadi, M. Hajikazemi, E. Rashidinejad, Y. Sinchuk and W. Van Paepegem
A hierarchical multi-scale analytical approach for predicting the elastic behavior of short fiber reinforced polymers under triaxial and flexural loading conditions
Composites Science and Technology 225

J. Sommer, M. Hajikazemi, I. De Baere and W. Van Paepegem
Experimental and numerical damage characterization of glass/polypropylene multidirectional laminates under quasi-static loading condition
Composites Science and Technology 227

M. Hajikazemi, H. Ahmadi, L.N. McCartney and W. Van Paepegem
A variational approach for accurate prediction of stress and displacement fields and thermo-elastic constants in general symmetric laminates containing ply cracking and delamination under general triaxial loading
International Journal of Solids and Structures 254

M. Soleimani, S.P. Maddala, M. Wismans, W.C. Liao, L.C.A. van Breemen, R.A.T.M. van Benthem and H. Friedrich
In Situ Fabrication, Manipulation, and Mechanical Characterization of Free-Standing Silica Thin Films Using Focused Ion Beam Scanning Electron Microscopy
Advanced Materials Interfaces 9 (11)

O. Atiq, E. Ricci, M.G. Baschetti and M.G. De Angelis
Modelling solubility in semi-crystalline polymers: a critical comparative review
Fluid Phase Equilibria 556

S. Taourit, P.Y. Le Gac and B. Fayolle
Relationship between network structure and ultimate properties in polyurethane during a chain scission process
Polymer Degradation and Stability 201

Functional Polymers and Surfaces

Publication

Z.P. Madzarevic, B. Seoane, J. Gascon, M. Hegde and T.J. Dingemans
Non-linear high Tg polyimide-based membranes for separating CO_2/CH_4 gas mixtures
Polymer 263

Polymers for Oil and Gas

Projects

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

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

#821: New Polymeric Surfactants for Enhanced Oil Recovery

#849: Feasibility study of enhanced oil recovery by Polymer Assisted Water-Alternating-Gas

Master thesis

Thijs van Wieren
The effect of water-soluble polymers on water-alternating CO_2 performance in porous media

DPI

DPI is a foundation funded by 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 80 researchers (PhDs and Post-Docs) are currently involved in DPI projects at knowledge institutes throughout the world.

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