ICMS Highlights

Edition 9
November 2017

The postdoc experience

INTERVIEW
/ Björn Baumeier

UNRAVELLING REGENERATION

INTERVIEW
/ Jurjen Tel

& more...

Institute for Complex Molecular Systems

TU/e Technische Universiteit **Eindhoven** University of Technology

Where innovation starts

ICMS Highlights

Creating an inspiring interdisciplinary atmosphere that drives impassioned researchers to go beyond the limits of their imagination is the challenge that we set ourselves at the ICMS. This approach leads to the discovery of exciting new scientific frontiers, while at the same time helping to continuously enhance the scientific toolbox needed to address academic and industrial research topics, in the field of complex molecular systems.

Increased pressure on funds and the global battle to attract and retain talent are examples of the challenges that science faces nowadays. Individual perseverance and the ability to look at scientific challenges from different angles are key to achieving breakthroughs. It is therefore with great pride that we congratulate three ICMS researchers, Tom de Greef, Patricia Dankers and Björn Baumeier, who all received an individual VIDI grant (800k€) in May 2017. This grant enables them to further explore and shape their leading-edge scientific endeavors. We must also congratulate Carlijn Bouten, whose project in the field of Materials-driven Regenerative Medicine in close collaboration with colleagues at Maastricht University and the University of Utrecht has been awarded a Gravitation grant (18,8M€) to go beyond the status quo. We are also very happy that prof. Sam Stupp of Northwestern University in Illinois has extended his collaboration with ICMS as a Distinguished Professor.

Over the past decade, ICMS researchers have made a significant impact in the field of complex molecular sciences in an ever dynamic and rapidly changing environment. We will continue to align all our efforts with internal and external factors to boost the basic sciences in Eindhoven.

We hope you enjoy reading this 9th edition of Highlights and that it contributes to your success,

Monique Bruining
Managing director

Bert Meijer
Scientific director

Calendar

November 14, 2017, 13.45 hr
SG / ICMS lecture Fraser Stoddart
Location: Blauwe Zaal

November 17, 2017, 15.00 hr
ICMS Discussion meeting Rachel Armstrong
Location: Ceres

November 24, 2017, 15.00 hr
ICMS Industrial Challenge
Location: Ceres

November 30, 2017, 10.00 hr
ICMS Minisymposium 'Illuminating Soft Matter'
Location: Ceres

November 27 – 29, 2017
ICMS Winterschool 'Molecular Engineering of Synthetic Biological Systems'
Location: Ceres

February 1 & 2, 2018
ICMS Outreach Symposium 'Molecular Science beyond Expectations'
Location: Blauwe Zaal

The complete calendar can be found on our website.

Content

Edition 9
November 2017

The postdoc experience
First collaborate, then innovate.

National centre for 4D-analysis of complex molecular systems
Strengthen the relationship between academia and industry via the ICMS Industrial Consortium.

Cover
Artist impression of dendritic cells on a surface, inspired by the work of Jurjen Tel (ICMS Animation Studio).

Entering the grey zone

Unravelling regeneration

You can't pigeonhole immune cells, but I do

p. 2
Calendar

p. 15 & 24
News, awards & grants

p. 18
EPL Update

p. 20
Top publications

p. 23
Nobel Prize for Chemistry 2016

p. 25
Theses ICMS

p. 27
Corporate information & ICMS in press

/ Björn Baumeier

Entering the grey zone

Simulating electronic processes in complex molecular assemblies

Solid state physicist Björn Baumeier drifted into the molecular sciences because excitons and electrons act peculiar at the mesoscopic level. By building and studying molecular assemblies in silico, he wants to explore this grey zone.

Two more Vidi-winners
Three ICMS scientists succeeded in getting an NWO Vidi grant. Patricia Dankers, associate professor in the groups Bio-Organic Chemistry, and Soft Tissue Biomechanics & Engineering, develops plastic implants with biological properties. Medical implants with 'bioactive signals' are expected to function better under mechanical loads and simulate formation of the desired type of tissue. Tom de Greef, associate professor at Computational Biology, wants to make a 'nano-slide gauge' based on DNA, with which he can measure interactions between cells and free-roaming proteins. The insight might be important in the development of new medicines.

His field of work is probably best described as computational chemistry, agrees Björn Baumeier with a bit of unease. “To be honest chemistry was anything but my favourite topic at high school or university,” he says almost apologizing. He always thought of himself as a hardcore physicist with a strong fling for mathematics. “But strictly speaking I left physics about ten years ago. I drifted into molecular sciences.” Why? “Because that’s where the real challenges in simulation are today.”

Baumeier focuses on a ‘grey field’ in simulations: electronic processes in molecular assemblies with dimensions of tens or hundreds of nanometers. At that level some of the most intriguing yet unexplained phenomena in electronics take place, he explains. Using his new NWO Vidi grant of 800k€ Baumeier wants to gain insight in the origins of two of these mysterious phenomena in the coming years: long-distance electronic transport and chiral-induced spin selectivity.

Life

Plants succeed in transferring excitation energy from photosynthesis over a relatively long distance with remarkable high efficiency. It is a crucial step in storing light energy and the basis of life as we know it. Baumeier: “How plants accomplish that is still largely unknown. It’s an interplay of electronic structure and molecular morphology. Grasping the underlying principles could teach us to produce more sustainable, energy efficient electronics ourselves.”

The other phenomenon that Baumeier is intrigued by is chiral-induced spin selectivity (CISS). Around 2008 Israeli physicists discovered that chiral materials work as spin filters. Either the electrons with spin up or those with spin down travel faster through chiral materials, depending on whether the molecules are right- or left-handed. Baumeier: “The filtering effect can’t be explained by spin-orbit coupling. Something else must be happening with the electrons on their journey through chiral molecules.”

ICMS is the perfect place to study both topics, thinks Baumeier. He is an assistant professor embedded in the department of Mathematics and Computer Science. The proximity of also experimental scientists in complex molecular systems is “one of the attractions of Eindhoven University of Technology.” He explains, “chemists at ICMS produce for example interesting helical systems that we are eager to simulate.”

Directions

Baumeier and his co-workers ‘built’ their molecular assemblies in silico. “As fundamental as possible,” he emphasizes. “We choose the most basic mathematic descriptions of atoms and their interactions available. Many of these algorithms we write ourselves, translating new theoretical ideas into code, into software. You don’t need simulations that just confirm your findings. They need to provide fundamental insight.”

Baumeier has made simulations of organic LEDs, organic solar cells and other solid state materials in the past years. “It helps companies and scientists to understand what is happening at the mesoscopic level. We can’t tell them ‘you will get a better blue LED using this or that molecule.’ But we can provide directions. For example: try using compounds with a higher polarizability in the excited state.”

Such advice may lead to better television screens, but also to energy efficient electronics or better catalysts, thinks Baumeier. “It’s the ultimate dream of all computational chemists to be able to predict exactly which molecules to synthesize to get a material with the properties you desire. But that’s beyond current calculation power. Yet we can help explaining what’s happening in molecular materials and tip which way designers should think.”

Baumeier and three of his co-workers have just moved into a room in the ICMS ‘headquarters’: the Ceres building. The next five years Baumeier will be engaged in establishing a clear group focus and an international reputation. “We will be tackling a lot of different electronic processes using our simulation techniques, and will keep improving our methodologies.”

Interview & text by
/ Valentina Bonito

The postdoc experience

The ambitious goal of ICMS is to become the leading international multidisciplinary institute for research and education in the area of complex molecular systems. ICMS intends to do this by acctracting talented young scientists, which have the unique opportunity to be trained in the hotspot for interdisciplinary science activities at the TU/e. In this ICMS highlights edition, 5 postdoctoral fellow researchers from different TU/e departments and groups share the stories of their previous academic backgrounds and the new ICMS experience.

First Collaborate, Then Innovate

Liu: "When you are surrounded by smart people, great ideas flourish easily, with the help of some lucky coincidences, too. I have been working on advanced charge transport simulation in disordered organic semiconductors, aiming at understanding the fundamental physics for device applications such as OLEDs, which is currently considered as the next generation technology for displays such as television and smart phone screens. Compared to conventional 1D simulation with empirical fitting parameters, our group at the TU/e developed a start-of-the-art 3D kinetic Monte Carlo simulation, where the fundamental physics at the molecular level is incorporated in a fully mechanistic way. The 3D simulation has advantages over 1D simulation in many aspects, such as inclusion of Coulomb correlation effect. However, it is important to show that this effect can not only be shown in simulation, but also be observed in realistic experiments. Luckily enough, at almost the exact same time I was considering the idea, the group of prof.dr.ir. Wilfred van der Weil from the University of Twente was carrying out experimental current-voltage measurements on ultra-thin organic devices that cannot be well explained by the conventional 1D model. Then we realized that this is exactly the situation where advanced 3D simulation is necessary and the experimental results show strong evidence supporting the Coulomb correlation effect shown in simulation. We shared data and results, benefiting from each other in an incredible way."

Fitzner: "At the TU/e I have not found a single scientist, research, or staff member who is not willing to help, share ideas and find, together, solutions." Since he re-joined TU/e and ICMS, Fitzner established several collaborations which lead to remarkable results and publications. Fitzner: "In the last years, I enjoyed working with scientists from different departments and with different backgrounds. This is, to me, the

primary goal and the added value of ICMS: bringing curious people together. Worth a mention is the collaboration with prof.dr.ir. Menno Prins, in which I could contribute to the understanding of protein corona formation and protein-protein interactions. Or, the work done on STORM signal with prof.dr. Bert Meijer first, and dr. Lorenzo Albertazzi later on, which resulted in a publication in Science in 2014."

Aleman Garcia: "A great idea is the result of the mixing of two very great ideas, coming quite often from two great minds that can communicate properly and collaborate effectively. This university knows that very well. The level of communication here, and within ICMS, is excellent. Within the Chemical Biology department, different groups have set up in the years several successful collaborations, and I am glad that I can benefit from this established network of scientists too. Also, being part of ICMS was an additional advantage for me in terms of networking with the outside world. Since I joined the Chemical biology group, I have been encouraged to join conferences and congresses to promote my work and to look for new inputs. For example, I recently joined the European Molecular Biology Conference, where I could learn super resolution microscopy techniques, a possibility I would have never had somewhere else. Or, at the International Conference on Supramolecular Chemistry and Nanoscience, I fruitfully interacted with a lot of scientists from all over the world performing high level research on supramolecular chemistry applied to biological systems."

"At the TU/e I have not found a single scientist, research, or staff member who is not willing to help, share ideas and find, together, solutions"

Proudly made in TU/e

Liu: "While working in the United States on charge and exciton modelling of organic semiconductors, I realized that Europe is leading the field in general with the most number of research groups. The group led by prof.dr. Bobbert and prof.dr. Coehoorn at TU/e is one of the best groups in the world with renowned high-quality scientific publications as well as in-depth understanding of the physics. Therefore choosing the TU/e as my next destination after finishing my PhD was quite an easy and spontaneous process."

Aleman Garcia: "After my first postdoc in Israel, where I specialized in supramolecular chemistry and DNA nanotechnology, I was determined to establish my own line of research: the application of supramolecular chemistry to biological systems. I applied for many groups in the world, and when I discovered about the research on supramolecular chemistry and protein-protein interactions of my current supervisor, prof.dr.ir. Luc Brunsveld, I realized that that was the exact type of research and scientific mindset I was looking for. In other universities, when talking about cross-contamination of several disciplines as my ideal research mentality, I had to deal with hesitation and scepticism. Here, I got in return enthusiasm and a job offer."

Europe vs Rest of the World

Liu: "I sometimes miss the possibility I had, during my time in the USA, to run simulations on top 500 super-computers in the world, where I do not need to worry about computational resources such as the number of available CPU cores and the capacity of disk space. However, the research level in Europe without that informatics luxury is extraordinary, and this tells a lot about the intellectual levels of the scientists enriching this continent. I am impressed by the high efficiency in the research output here in the Netherlands compared with the available resources. If I look at my home country instead, China, I see with the growth of economy, the level of scientific research has improved tremendously in the last decades. However, considering the scientific achievements divided by population, China is still far behind the Netherlands."

Fitzner: "In Berlin and Stockholm, while being a student and later a postdoc, I saw little interaction between the groups and sometime even within groups. Due to the size, it might not be fair to compare Berlin, with a total of around 175,000 university students, to the 10,000 students at TU/e. However, coming to Eindhoven in

2008, I was impressed by the cooperation between the universities in the Netherlands, at the level of organization as well as the collaboration between the groups working in the same field. ICMS takes the next step to promote the collaboration been the groups working in different fields."

Grosso: "My first postdoc experience was in Austria, at the University of Graz. When looking back at those times, the familiar and friendly environment I experienced there was pretty unique and difficult to replicate somewhere else. However, unfortunately, the European project I was working at was too ambitious for the mathematical models and the experience the consortium could offer. Moreover, along the way, personal issues among the

> **"At ICMS and within our group it all starts with sharing: sharing of equipments, facilities and, ultimately, ideas"**

partners of the project came up, further compromising the success of the work. Eventually, I decided to start looking for a second postdoc position in Eindhoven. A professor I knew put me in contact directly with prof. dr.ir. Patrick Anderson, who offered me the possibility to work on a project at the polymer technology group at TU/e, funded by the company ColorMatrix. After 2 years of work at the modelling of the mixing of polymers and colours, I recently started two new projects, still under the supervision of prof.dr.ir. Anderson, which focus instead on crystallization of polymers and particle filled extrusion. Working in a such a consolidated group, with a strong background and clear mission, has been an undeniable change of pace for me, especially when compared to my previous academic and industrial experiences."

Shared facilities, shared ideas

Grosso: "At the polymer technology group, we have working tools such as codes and programs developed internally, which have proven to be a precious resource for all the students, researchers and staff members. The story and the future of the group lies in those shared codes. Also, past and present PhD projects and the independent research performed within our group are all tiny and perfectly matching pieces of the same, big puzzle. This helps defining clearly the mission of the team and our expertise within the TU/e cosmo and the scientific world outside."

Yan: "At ICMS and within our group it all starts with sharing: sharing of equipments, facilities and, ultimately, ideas. The interaction within the group and with other groups is what I like the most. Also, the organization is really good, and breaking boundaries is a possibility more than a worrying obstacle. The regular events organized by ICMS are the constant proof of the shared willingness to learn from each other: from small meetings with a targeted audience, like the ICMS biosensor meeting, to bigger events like the winter schools, workshops or the ICMS Outreach Symposia. Also, the resources here are simply amazing, and accessible to everyone. And, in return, the science performed is valuable and competitive."

Fitzner: "As a mathematician, I feel like the odd one amongst the melting pot of chemists, physicists, biologists populating ICMS. Between each field there are major differences. The one that everyone first encounters is the (scientific) language barrier, that needs to be overcome when doing any interdisciplinary work. ICMS, with its symposia, seminars or winter schools, makes us very aware of these difference and makes the first step to overcome them. For me as a mathematician another differences is equally obvious, namely how we (are trained to) approach a problem. While I also saw differences between chemistry and biology, the differences to mathematics are understandably the biggest. As a mathematician my first step is to remove unwanted complexity. To forget the big picture, at least for the moment, and ask: What are the basic mechanisms we understand? What do we need to assume about them, as we do not have a way to know better? What can we measure and compare? What goals can we actually achieve? I believe that 80% of my contribution to ICMS projects were the long discussions to answer these questions. I learned a lot from these discussions and hope to have more of those in future projects."


Robert Fitzner


Feilong Liu


Miguel Angel Aleman Garcia


Junhong Yan


Giovanna Grosso

Robert Fitzner, PhD
Robert Fitzner studied mathematics at the Berlin University of Technology. In 2008, Fitzner started his PhD project on percolation and lace expansion at the TU/e University of Technology under the supervision of prof.dr. Remco van der Hofstad. From 2013 to 2015, Fitzner worked as a postdoctoral research fellow at the Department of Epidemiology of the University of Stockholm. In 2015, Fitzner returned to the Netherlands for a postdoc position the TU/e under the guidance of prof.dr. Remco van de Hofstad. The research of Fitzner is in the field of statistical physics, probability and the spatial evolution of systems, such as the occurrence of phase transitions and critical phenomena, held together by a strong background on mathematical models, algorithms and programming.

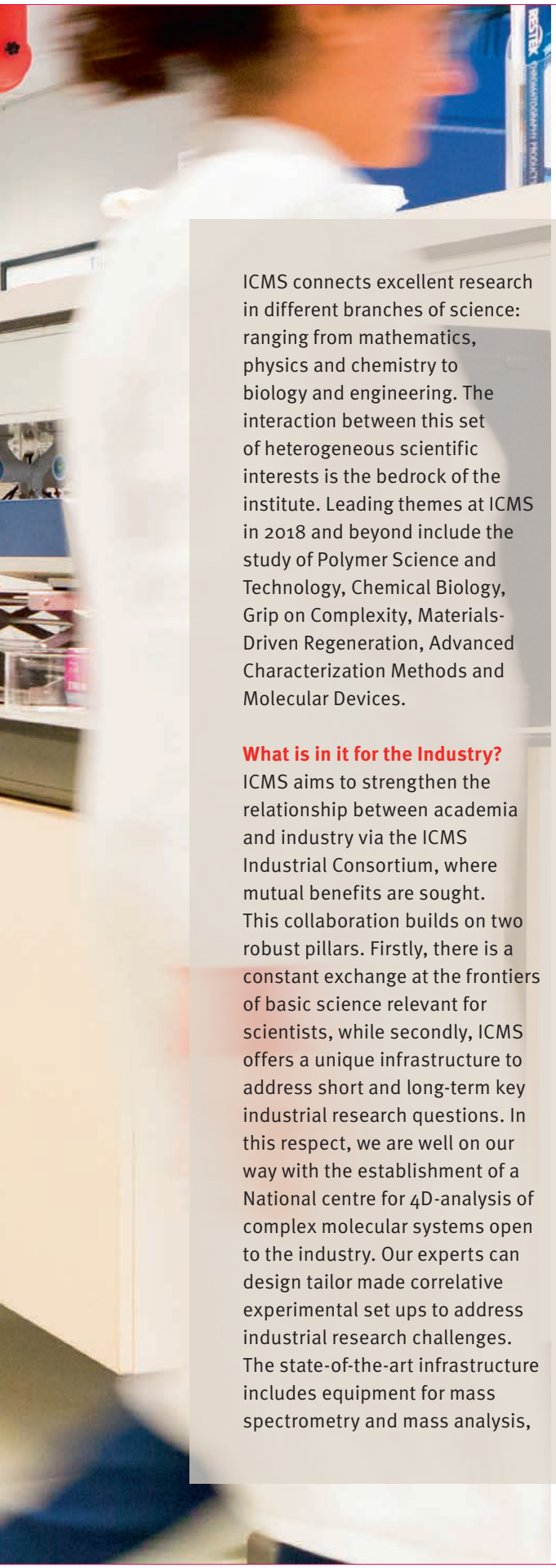
Feilong Liu, PhD
Feilong Liu obtained his bachelor degree in 2009 in microelectronics from Peking University, Beijing, China. Afterwards, he moved to the USA to the University of Minnesota, where he obtained his PhD in electrical engineering in 2015. His research focused on modelling and simulation of charge and exciton transport in organic semiconductor devices. In 2015, Liu joined the group of Molecular Materials and Nano Systems at the Department of Applied Physics of the TU/e University of Technology as a postdoctoral researcher. Under the guidance of prof.dr. Peter Bobbert and prof.dr. Reinder Coehoorn, Liu currently works on advanced simulation methods and their application in disordered organic semiconductors.

Miguel Angel Aleman Garcia, PhD
Miguel Angel Aleman Garcia studied chemistry at the University of Puebla, Mexico. He obtained his PhD from the University of Cambridge in 2012 in the group of Dr. Nick Bampos. During his doctoral studies, he investigated the synthesis and assembly of supramolecular interlocked systems. In 2013, he moved to Israel to start a postdoctoral position in the group of prof. Itamar Willner, working on hybrid DNA-nanomaterials. Since November 2016, he is a postdoctoral researcher in the group of Chemical Biology, under the guidance of prof.dr.ir. Luc Brunsveld. His current research involves the use of peptide binding proteins and DNA functional structures.

Junhong Yan, PhD
Junhong Yan obtained her bachelor degree in biotechnology and drug development in China. Afterwards, she moved to Uppsala, Sweden, for a master program in microbiology. In 2010 she started a PhD project in the group of Molecular Medicine, working with method development of sensitive and specific measurement of proteins in solutions via antibodies tagged with small fragments of DNA. Since 2015, Yan is a postdoctoral researcher in the group of Molecular Biosensors for Medical Diagnostics led by prof.dr.ir. Menno Prins, at the Department of Applied Physics of the Eindhoven University of Technology. Her current work focuses on protein-protein interactions on particle surfaces and the development of biosensors for the continuous monitoring of chemical and biochemical markers, which are based on particle mobility sensing and substrates' binding via specific and reversible interactions.

Giovanna Grosso, PhD
Giovanna Grosso graduated cum laude in civil engineering (hydraulics) at the University of Genova, Italy. In 2006, she started a PhD at the University of Genova, in the group of Fluid Dynamics and Environmental Processes, which resulted in a PhD thesis on the modelling of sea waves' propagation. In 2009, she started working as an R&D engineer at Ansaldo Energia in Genova, focusing on the design of innovative gas turbine combustion systems and the numerical modelling of pressure losses, heat transfers and thermo-acoustic instabilities. In 2012, Grosso moved to Austria for a postdoctoral research position at the Combustion Engines and Thermodynamics Department of the Graz University of Technology. From 2012 to 2014, her research interests shifted toward numerical modelling of air pollution and odour dispersion. In 2014, she joined the polymer technology group of prof.dr.ir. Patrick Anderson at the TU/e University of Technology. Currently, she works on the numerical modelling of flow and mixing of complex fluids.

National centre for 4D-analysis of complex molecular systems



ICMS connects excellent research in different branches of science: ranging from mathematics, physics and chemistry to biology and engineering. The interaction between this set of heterogeneous scientific interests is the bedrock of the institute. Leading themes at ICMS in 2018 and beyond include the study of Polymer Science and Technology, Chemical Biology, Grip on Complexity, Materials-Driven Regeneration, Advanced Characterization Methods and Molecular Devices.

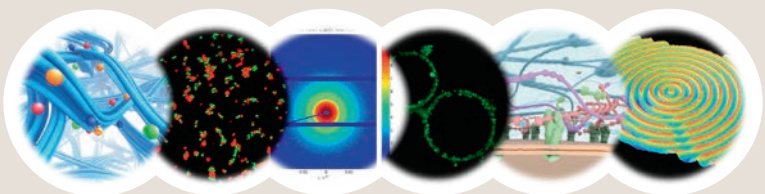
What is in it for the Industry?

ICMS aims to strengthen the relationship between academia and industry via the ICMS Industrial Consortium, where mutual benefits are sought. This collaboration builds on two robust pillars. Firstly, there is a constant exchange at the frontiers of basic science relevant for scientists, while secondly, ICMS offers a unique infrastructure to address short and long-term key industrial research questions. In this respect, we are well on our way with the establishment of a National centre for 4D-analysis of complex molecular systems open to the industry. Our experts can design tailor made correlative experimental set ups to address industrial research challenges. The state-of-the-art infrastructure includes equipment for mass spectrometry and mass analysis, NMR spectroscopy, other general spectroscopies (UV-VIS, PL, FT-IR, CD, polarimetry), chromatography, thermal analysis, peptide synthesizers, X-Ray scattering, Light Scattering and an extensive range of microscopes (electronic, optic, polarized, fluorescent, confocal, etc.). These techniques allow for the characterization and study of systems from the molecular scale up to the mesoscale level. Correlating data of different techniques, at all relevant length scales at any point in time on one specific sample, is the key to understand and ultimately steer the structure – property relationship(s) in these systems. Therefore, to comprehend their working mechanisms, we must obtain deep insights into the evolution of morphology, structure and chemical composition in these different systems during their formation, but also during their performance.

The uniqueness of the ICMS Consortium makes it a perfect matrix for new multi-disciplinary and creative collaborations to collate knowledge and address industry challenges. We are also very keen that ICMS scientists get inspiration for new scientific ventures based on relevant research challenges raised by industry.

We invite you to share your challenges with us and be part of our community.

ICMS FACILITATES MORE THAN 200 LECTURES EVERY YEAR OPEN TO ACADEMIC & INDUSTRIAL PARTNERS



Unravelling regeneration

NWO Gravitation program awards Materials-Driven Regeneration consortium

There is no doubt about the potential of regenerative medicine. The question is whether its scope can also include patients that suffer from (multiple) chronic diseases. The newly founded Materials-Driven Regeneration (MDR) consortium takes on this challenge and develops innovative biomaterials to come up with therapeutic solutions. But the focus on applications is not taking the upper hand. "First, we need to understand how to drive and harness regeneration on a very fundamental level."

Our body's potential to regenerate is huge. Cuts are healed, dysfunctional cells are replaced, fractures are replenished and worn-down tissues are renewed all the time. The field of regenerative medicine taps into this potential by developing therapies that support the body in putting its own regenerative capacity to maximum use. Helping the body help itself, as it were.

Regenerative medicine is a booming field that spans a range of therapeutic strategies. From administering stem cells or transplanting lab-cultured tissues to implanting cell-free biomaterials that act as scaffolds for the formation of new, healthy tissues inside the body. An intriguing example of the latter is the work by ICMS-member Carlijn Bouten on heart valves. Bouten, professor of Cell-Matrix Interactions at the department of Biomedical Engineering, is spearheading the development of an implantable, biodegradable scaffold that recruits cells to grow into a new heart valve. In preclinical studies in sheep, this approach has shown to result in fully functional heart valves. A first clinical study in children is ongoing. The big question now is whether this approach is applicable to older patients, particularly when comorbidity – additional diseases next to the primary disorder – comes into play. "What about elderly patients who also suffer from diabetes or kidney failure? Is our strategy even possible in such cases? We don't know", says Bouten. But it is a highly relevant question considering the ageing of the population and the increase in the number of people suffering from chronic diseases.

Deeper level

The MDR consortium (see box), led by Bouten, aims to unravel the mechanisms that underlie our body's regenerative capacity in health and disease and build a sound scientific understanding of how regeneration can be harnessed under these conditions with intelligent materials. "The vast majority of patients affected by cardiovascular diseases are chronically ill. The same goes for musculoskeletal disorders. Take for example osteoporosis, which is extremely rare in young people, but is quickly becoming a major problem among the elderly. By focusing on chronic diseases, we can potentially benefit the health of large numbers of people, thus creating huge impact." Bouten emphasizes that although realizing this impact is a major motivation for the MDR consortium, the true scientific challenge is to be found on a deeper, more fundamental level. "There are plenty of examples that demonstrate the potential of regenerative medicine, but we lack a thorough understanding of how we can control the body's regenerative capacity", Bouten explains. "The fundamental challenge of the MDR program is to investigate, design and apply materials that drive the processes of regeneration inside the human body. Not only in young patients, but also when age and disease start playing a role. For this we first need a deep understanding of the basic mechanisms that control regeneration before we can start thinking about new material-based therapeutic solutions. How is regeneration affected by age? We know that the regeneration potential of newborns is very high and that it decreases with age. When does it stop? And what is the role of comorbidity? But foremost, we need to understand how we can control these processes with materials that sense and instruct their biological environment."

"We lack a thorough understanding of how we can control the body's regenerative capacity"

NWO Gravitation subsidy for Materials-Driven Regeneration consortium

In May of this year, the MDR consortium was awarded 18,8M€ through the Gravitation ('Zwaartekracht') program of the Netherlands Organisation for Scientific Research (NWO). The MDR consortium is headed by Carlijn Bouten of TU/e and brings together internationally renowned scientists in cell biology (Hans Clevers, Hubrecht Institute), biomaterials (Pamela Habibovic, Maastricht University), nephrology and vascular biology (Marianne Verhaar, UMC Utrecht), tissue engineering (Clemens van Blitterswijk, Maastricht University) and material science (Bert Meijer, TU/e, ICMS). Other ICMS members participating in the MDR program are Patricia Dankers, Keita Ito, Jan van Hest, Cecilia Sahlgren, Sandra Loerakker, Tom de Greef, Nicholas Kurniawan, Sandra Hofmann, and Nico Sommerdijk.

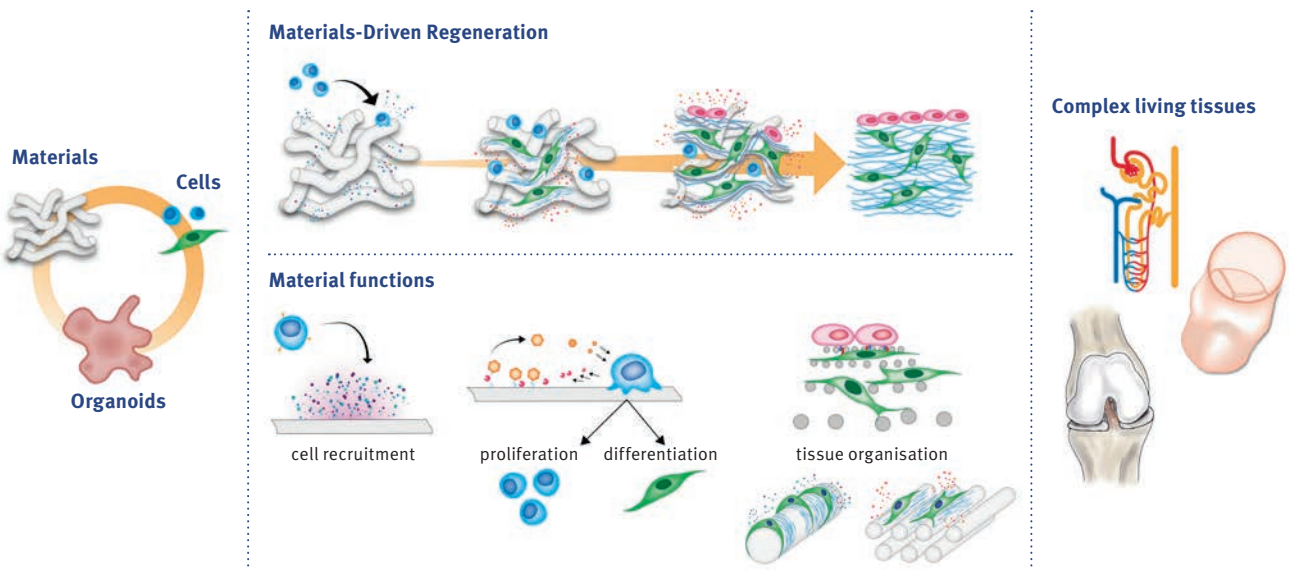
> “If we want to realize the full potential of regenerative medicine, we need cross-fertilization”

Uncompromising research

The Gravitation subsidy offers the perfect starting point to really dive into these questions, says co-applicant Clemens van Blitterswijk, professor of Tissue Engineering at Maastricht University and director of MERLN, Institute for Technology-Inspired Regenerative Medicine. “Even though societally relevant applications are the ultimate goal of the Gravitation program, it provides the freedom and time to explore a very fundamental route towards those applications. It allows for uncompromising research and the long-term perspective offers continuity. Essential for science in general and particularly for the next generation of research leaders in the consortium who need stability to build their own research lines.” Furthermore, when it comes to applications, Van Blitterswijk points to the RegMed XB program, which received 25M€ in 2016. “The groups involved in RegMed XB are the same as in the MDR consortium with addition of research groups from Leiden University and University Medical Center. It is a seamless fit between the more fundamental approach of MDR and the stronger focus on clinical applications that drives the RegMed XB consortium. This way, we can keep filling the pipeline.”

Bridging gaps

New entries to that pipeline will come from merging the various areas of expertise that come together in the MDR consortium. Van Blitterswijk: “The groups in Eindhoven and Maastricht deploy the properties of materials to influence the behavior of cells. In Utrecht, they know all about cell biology and the group of Bert Meijer develops very interesting materials.” Bringing all this together and bridging the gaps between the different types of tissues – bone, cartilage, heart, arteries, kidney – is what makes the MDR program stand out, says Bouten. “If we want to realize the full potential of regenerative medicine, we need cross-fertilization. Between techniques, between applications and between levels of tissue organization, not only focus on cells or tissues or organs, but on all three. You need to understand cellular behavior ánd the environment of the cells that determines the architecture of the tissue ánd the way different tissues come together to create a complex organ. Our approach spans all these levels and that is really new to the field.”



NEWS, AWARDS & GRANTS

World first: new polymer

GOES FOR A WALK

when illuminated

Anne Hélène Gélébart

Scientists at Eindhoven University of Technology and Kent State University have developed a new material that can undulate and therefore propel itself forward under the influence of light. To this end, they clamp a strip of this polymer material in a rectangular frame. When illuminated it goes for a walk all on its own. This small device, the size of a paperclip, is the world's first machine to convert light directly into walking, simply using one fixed light source. The researchers publish their findings on 29 June in the scientific journal Nature. The paper in Nature is entitled 'Making waves in a photoactive polymer film (DOI 10.1038/nature22987). The authors are Anne Hélène Gélébart, Dirk Jan Mulder, Michael Varga, Andrew Konya, Ghislaine Vantomme, Bert Meijer, Robin Selinger and Dick Broer. The empirical study took place in Eindhoven with the corresponding theoretical model being developed in Kent, Ohio. The research was made possible by subsidies from the Dutch research funding agency NWO and the European Research Council.

'MAKING LIFE' IN NEMO

Since 2012, a reproduction of the Miller Urey experiment has run in the NEMO Science Museum in Amsterdam with the name 'Making Life'. This experiment was stopped after 5 years and brought to Eindhoven to be analyzed. Rob van Hattum, Chief Science Officer of NEMO, and Bert Meijer started this project to see whether it would be possible to produce the building blocks of life. Two master students, Martin van Son and Marle Vleugels, have investigated the liquid after it was brought to Eindhoven together with Joost van Dongen. Three natural amino acids were present: glycine, alanine and β-alanine. Furthermore, a non-natural amino acid was present: 4-aminobutanoic acid. Since in science an experiment is not an experiment without having a duplo, the same experiment is planned for another 5 years in NEMO to look at reproducibility. Also, two variations on this experiment, one with added clay and one with UV-light instead of a spark discharge, will be tested.

Marle Vleugels and Martin van Son

Professor Carlijn Bouten

'GRAVITATION'

subsidy for Materials-Driven Regeneration (MDR) program

Heart failure, kidney failure and worn intervertebral discs – these are problems that in the future the body will have to be able to remedy itself. So top scientists at TU/e, Maastricht University and Utrecht (UMC Utrecht, Hubrecht Institute and Utrecht University) will be developing intelligent biomaterials that activate and guide the self-repair capacity of the body. Education minister Jet Bussemaker announced on Monday 8 May that their research program, known as MDR, has been awarded a Gravitation subsidy (Zwaartekrachtsubsidie) worth 18.8 million euros. The universities themselves will be investing jointly six million in the program.

MDR will be led by six top-notch scientists, all with considerable experience in leading pioneering research projects. TU/e professor Carlijn Bouten (cardiovascular regeneration) is coordinating the program that connects the best scientists in the Netherlands in the fields of material science (Bert Meijer, ICMS, TU/e), cell biology (Hans Clevers, Hubrecht Institute), tissue engineering (Clemens van Blitterswijk, Maastricht University), nephrology and vascular biology (Marianne Verhaar, UMC Utrecht) and biomaterials (Pamela Habibovic, Maastricht University).

SENSUS 2017

Visitors, votes and winners

The exciting finals of SensUs 2017 took place at Eindhoven University of Technology on the 8th and 9th of September. Ten teams came together from Sweden, Denmark, Scotland, England, Belgium, Netherlands, Germany, Switzerland, Egypt, and the USA. The teams competed to inspire the public and convince the jury of their biosensors for the detection of heart failure. The biosensors were tested by measuring NT-proBNP in blood plasma. Visitors from all over the world watched the tests live on the online SensUs Digital platform. Furthermore, all could cast votes on their favourite teams for winning the Public Inspiration Award. A total of 1500 people voted and the cumulative visitor count was 5000, from 74 countries.

The teams showed their biosensors and presented several lively pitches. They were judged by an international multidisciplinary jury on Analytical Performance (the best measurement of NT-proBNP in blood plasma), Translation Potential (probability that the concepts will make it into society), and Creativity (novelty of approach). These results are available on the website www.sensus2017.org.

Next year 13 universities will participate: all universities of SensUs 2017, and 3 new ones from Canada (Montreal), China (Zhejiang), and Spain (Barcelona). The theme of SensUs 2018 is “Dosing of drugs is personal” and the teams will develop biosensors for the measurement of Vancomycin, a very important antibiotic.

VENI AWARD

for Ghislaine Vantomme

Researcher dr. Ghislaine Vantomme (31) has received a Veni grant, which she plans to use to conduct research at TU/e. The Netherlands Organisation for Scientific Research (NWO) has awarded a Veni grant, which amounts to 250k€ in funding, to 154 researchers who have recently received their doctorate. This funding enables promising young scientists to continue developing their ideas over a three-year period. French researcher dr. Vantomme will built on the world first recently presented research by TU/e researchers in Nature on photo-actuators. She wants to create self-oscillating surfaces able to move continuously under sunlight. These new materials will be used to develop self-cleaning windows and to transport liquid through pipes and membranes.

ICMS OUTREACH SYMPOSIUM 2018

Molecular Science beyond Expectations

ICMS, in cooperation with EPL, cordially invites you to the Outreach Symposium 2018. Research talents from the TU/e and from around the globe will take you on an inspiring and intriguing scientific journey through plowed and unplowed areas of complex molecular systems. We anticipate that the Outreach Symposium 2018 will catalyze the formation of new connections between participants and will equip you with new insights to strengthen your research endeavors.

Date: 1 and 2 February 2018
Location: Eindhoven, University of Technology, the Netherlands (TU/e), Blauwe Zaal, Auditorium
Program: More details on the program will be provided via de website of ICMS
www.tue.nl/ICMSOutreachSymposium

The first day invited speakers and poster presenters will share their ideas on designing the next generation of polymer materials through multi-material and hierarchical strategies. Participants can learn more about the TU/e expertise and the lab facilities during the presentations as well as during the lab tours. We are also very proud to facilitate the final event of the ICMS Industrial Challenge competition. Young TU/e research talent will pitch their creative solutions to real life industrial challenges.

On *the second day* the recently granted Gravitation program, Materials-Driven Regeneration, spear-headed by prof.dr. Carlijn Bouten, in collaboration with partners from Regenerative Medicine Utrecht (RMU) and the Institute for Technology-Inspired Regenerative Medicine (MERLN) in Maastricht, will be presented by the consortium members. The central goal of this program is to investigate, design and use intelligent biomaterials that drive and reinforce the body's own regenerative power to contribute to the curing of a number of chronic diseases. It excites us that renowned speakers will headline their cutting-edge strategies in the area of biomaterials for the benefit of regenerative medicine during this Symposium.

We very much look forward to interacting with you at the upcoming Outreach Symposium 2018.

EPL Update

Eindhoven Polymer Town

Polymer science and technology have been research topics in Eindhoven since the start of our University. However, it was not until 1985 that it really became one of the most – if not the most – prominent research topic at the TU/e. In that year, Piet Lemstra moved from DSM to our University and with him everything changed.

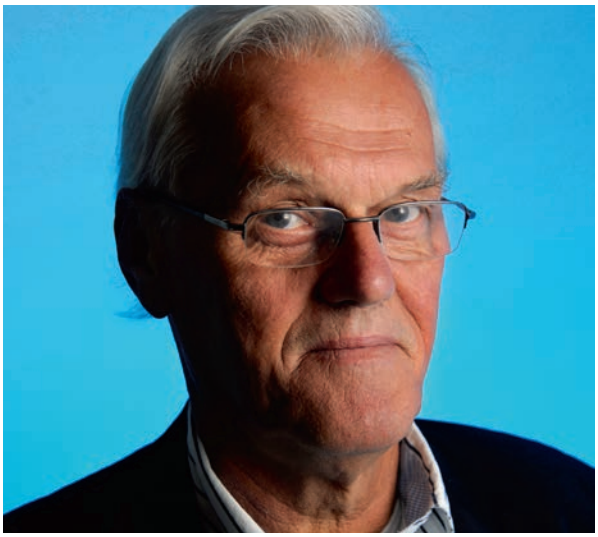
First the Center for Polymers and Composites (CPC) was created upon the arrival of Han Meijer to Eindhoven. The CPC became the nucleus for rapid growth in activities spanning the whole spectrum of polymer science and engineering, all stemming from the core knowledge so successfully built by Piet Lemstra. Many TU/e researchers moved into this exciting field, eventually leading to the Eindhoven Polymer Laboratories (EPL). Eindhoven became Polymer Town and, although being national initiatives, the Dutch Polymer Institute and Polymer Technology Netherlands also have strong ties to Eindhoven.

> "Polymer science and engineering remains one of the pillars of our University"

Through the years, research topics have changed and polymer research has become more and more an enabling science for areas like regenerative medicine, energy research, and nanotechnology. This and the retirements of Piet Lemstra and Han Meijer have resulted in decreased visibility for Eindhoven as Polymer Town. However, polymer science and engineering remains one of the pillars of our University. Since EPL was founded, many leading polymer scientists and industrial researchers have visited Eindhoven to share their science or their challenges with us. In an unprecedented way, Eindhoven has combined science and engineering in such a way that both fundamental science and industrially relevant research flourish side-by-side. In order to make this research area more visible for the outside world, ICMS will focus on strongly promoting the research achievements in polymers with a number of actions.

As a start, the 2018 ICMS Outreach Symposium will give our polymer activities a central position. On the first day, keynote lectures by Jan van Hest and

Han Meijer



Piet Lemstra

Jan Vermant of the ETH in Zürich will be combined with lectures of PhD students showing the broad spectrum of activities. With lab tours we will show our outstanding infrastructure. The second day marks the start of the new gravitation program “Materials-Driven Regeneration,” a joint program that brings scientists of Utrecht, Maastricht and Eindhoven together in the area of tissue engineering. Also in this field polymers are crucially important, which we will highlight with keynote lectures by Sam Stupp and Eva Harth.

Sophisticated characterization of polymer materials in space and time at different length and time scales is a prerequisite to progress. ICMS, together with the departments, is continuously investing in new instrumentation, making it a premier facility for material characterization. Microscopy, both with electrons and photons, and advanced scattering characterization are just a few techniques that enable us to acquire essential information at the mesoscale. We will do everything to realize a national center with the most sophisticated instrumentation for the 4D characterization of polymer materials.

Defect engineering is another research topic in materials science with increasing importance. Minimizing uncontrolled defects or engineering designed functional defects will become essential to arrive at ultimate properties and functions. Success requires a comprehensive battery of sophisticated synthetic protocols as well as advanced processing and characterization techniques. ICMS is highly enthusiastic in a strong collaboration with the Max Planck Institute for Polymer Research in Mainz on this topic. Both institutes have complementary research interests and together they can make the difference in this highly demanding and competitive research topic.

Finally, ICMS and EPL will continue to attract the best scientists to come to Eindhoven, either for a few days, a month, a few years or for a full career. Special emphasis will be on our Distinguished ICMS Visiting Professors program. In this context, we are very proud to welcome Frank Bates from the University of Minnesota for his stay with us in May 2018. We invite everyone to share his or her research with Frank during his stay. With all these initiatives the scientists of ICMS and EPL will continue to stimulate polymer science and engineering in Eindhoven. We will do everything to keep the stimulating initiatives of Piet Lemstra and Han Meijer alive.

ICMS TOP PUBLICATIONS

April 2017 – October 2017

1. *P.J.M. Smeets, A.R. Finney, W.J.E.M. Habraken, F. Nudelman, H. Friedrich, J. Laven, J.J. de Yoreo, P.M. Rodger, N.A.J.M. Sommerdijk*
A classical view on nonclassical nucleation
PNAS, 114, 7882-7890 (2017)

2. *J.J.F. Sleeboom, P. Voudouris, M.T.J.J.M. Punter, F.J. Aangenendt, D. Florea, P.P.A.M. van der Schoot, H. Wyss*
Compression and reswelling of microgel particles after an osmotic shock
Phys. Rev. Lett. 119, 098001 (2017)

3. *P.J. de Vink, J.M. Briels, T. Schrader, L.G. Milroy, L. Brunsveld, C. Ottman*
A binary bivalent supramolecular assembly platform based on cucurbit[8]uril and dimeric adapter protein 14-3-3
Angew. Chem. Int. Ed. 56, 8998-9002 (2017)

4. *G. Koçer, J. ter Schiphorst, M. Hendrikx, H.G. Kassa, P.E.L.G. Leclère, A.P.H.J. Schenning, P. Jonkheijm*
Light-responsive hierarchically structured liquid crystal polymer networks for harnessing cell adhesion and migration
Adv. Mater. 29, 1606407 (2017)

5. *M.F.C. Romera, R.P.M. Lafleur, C. Guibert, I.K. Voets, C. Storm, R.P. Sijbesma*
Strain stiffening hydrogels through self-assembly and covalent fixation of semi-flexible fibers
Angew. Chem. Int. Ed. 56, 8771-8775 (2017)

6. *A. Das, G. Vantomme, A.J. Markvoort, H.M.M. ten Eikelder, M. Garcia-Iglesias, A.R.A. Palmans, E.W. Meijer*
Supramolecular copolymers: structure and composition revealed by theoretical modeling
J. Am. Chem.Soc. 139, 7036-7044 (2017)

7. *X. Lou, R.P.M. Lafleur, C.M.A. Leenders, S.M.C. Schoenmakers, N.M. Matsumoto, M.B. Baker, J.L.J. van Dongen, A.R.A. Palmans, E.W. Meijer*
Dynamic diversity of synthetic supramolecular polymers in water as revealed by hydrogen/deuterium exchange
Nature Commun. 8, 15420 (2017)

8. *A.H. Gelebart, G. Vantomme, E.W. Meijer, D. Broer*
Mastering the photothermal effect in liquid crystal networks: a general approach for self-sustained mechanical oscillators
Adv. Mater. 29, 1606712 (2017)

9. *A.H. Gelebart, D.J. Mulder, M. Varga, A. Konya, G. Vantomme, E.W. Meijer, R.L.B. Selinger, D.J. Broer*
Making waves in a photoactive polymer film
Nature, 546, 632-636 (2017)

10. *M. Mas-Montaya, R.A.J. Janssen*
The effect of H- and J-aggregation on the photophysical and photovoltaic properties of small thiophene-pyridine-DPP molecules for bulk-heterojunction solar cells
Adv. Funct. Mater. 27, 1605779 (2017)

11. *S. van Dun, C. Ottmann, L.G. Milroy, L. Brunsveld*
Supramolecular chemistry targeting proteins
J. Am. Chem. Soc. 139, 13960-13968 (2017)

This overview lists publications in high end journals with ICMS as affiliation.

/ Jurjen Tel

You can't pigeonhole immune cells, *but I do*

A puzzle isn't solved until you find the last piece. The human immune system is one of the most complex and fascinating puzzles to me. It saves each of us every day again by fighting the viruses and bacteria that we encounter and by cleaning up derailed cells. But we don't exactly know how.

FACTS

Our body is estimated to comprise over

35 trillion cells:

35,000,000,000,000. Just 1 can start a complete immune response.

Although elephants have

80 times

more body-mass than humans they rarely develop cancer - Peto's paradox.

It's a highly complex and flexible system as it needs to fight off a wide range of dangers. That high level of plasticity is achieved by a range of signalling molecules, cell types and specialized subtypes. The complexity is so large that one can easily feel lost in studying the system. I believe that we can clarify the bigger picture by defining all small pieces of the puzzle. Developing and applying engineering tools to study the immune system in health and disease, is exactly what I plan to do as the groupleader of immunoengineering in Eindhoven. The results will help improving existing immunotherapies or designing novel ones.

Dolloriatium voloruntia

My current focus is on dendritic cells. These DCs are key regulators in pathogen sensing. They teach other immune cells exactly who the 'bad guys' are. DCs can pick up fragments of intruding cells or malignant tissue and present them to other cells to start a highly specific defence. My favourite subtype is the plasmacytoid dendritic cell (pDC). Upon encounter of pathogens or other threats pDCs secret large amounts of a protein called type I interferon, an important signalling molecule that boosts the immune system as a whole. I find it fascinating how human pDCs, as an extremely rare subset of cells can act as Swiss army knives to regulate the tight balance between tolerance and immunity: i.e. they secrete massive amounts of type I IFNs, are capable of priming T cells and exert cytotoxic effector functions.

In the past years, I have developed a technology platform to study cells individually. It includes on-chip technology that locks up cells separately in small microdroplets or chambers. Studying individual pDCs is the only way to unambiguously elucidate which cellular properties correlate with distinct functions. Furthermore it allows us to combine subtypes in one microdroplet to decode their interactions. This technology will be running soon at the new ML-1 laboratory in Ceres.

Dolloriatium voloruntia

Artificial immunotherapy is another topic that I will address the coming years in Eindhoven, together with the group of Jan van Hest. We try to design and synthesize artificial antigen presenting cells: vesicles or nanoparticles that carry antigens and can present these to the immune system like their natural counterparts, the DCs, do. Synthetic cells may prevent or reduce toxicity and side effects of immunotherapy. Furthermore, we aim to trigger the immune system locally by application of scaffolds, materials that slowly release compounds and that allow local and precise control over the microenvironment.

The ultimate goal of my research is, to have significant impact on immunotherapeutic strategies. The past years immunotherapy has definitely been the 'hottest

thing' in cancer treatment. It's also a highly logical approach as cancer cells only survive by dodging or silencing our natural defence. Yet, there is no miracle treatment. Immunotherapy doesn't work for all patients and severe side effects do occur. Successful immunotherapy against cancer, or auto-immune and infectious diseases, is the result of numerous cellular interactions. By gaining better insight into the regulation of the complex immune system we may improve existing or develop novel therapies.

Dolloriatium voloruntia

For me the potential application of research results in health care is an important drive. During my PhD-studies at the Radboudumc, I was directly involved in the world's first clinical vaccination trial using activated pDCs for end-stage melanoma patients. At that time, the treatment was often their last hope of survival. It was a very impressive experience to meet them personally. It makes your research highly relevant, exciting and important, but it also made me feel very humble.

Becoming a scientist is what I've always wanted; ever since I was a teenager and my uncle took me to his laboratory to do small experiments during vacations. Ultimately, I want to become a full professor in immunoengineering. A professorship provides the opportunity to realize your own independent research ideas, and I always have more ideas than 'hands'. Thoughts about new experiments keep me busy all day. My co-workers and colleagues know that. I call them at the strangest hours to discuss a new idea. Yes, even in evenings, weekend or at my 'daddy days'.

Nobel Prize for Chemistry 2016

Sir Fraser Stoddart

The Dutch science community reacted with great excitement on Wednesday, October 5, 2016 at the announcement of the Nobel Prize for Chemistry. Three eminent chemists were awarded for their achievements in the design and synthesis of molecular machines. With Ben Feringa, Jean-Pierre Sauvage and Sir Fraser Stoddart, we not only have the first Dutch Nobel Prize winner in years, but also three chemists with close connections to Eindhoven and ICMS. We celebrated these three Prizes and the other Nobel Prizes in our yearly ICMS-TU/e Nobel Prize evening event in the Zwarte Doos.

Ben Feringa often visits our University – most recently, he presented his newest work in January 2016. We were also very pleased to welcome Sir Fraser Stoddart to Eindhoven to receive the 2017 Netherlands Award for Supramolecular Chemistry. This honor is awarded by the Gravitation Program "Functional Molecular Systems," a program that brings the organic chemists of Eindhoven, Nijmegen and Groningen together. With exciting lectures about his breakthroughs in introducing the mechanical bond in chemistry and his journey to Stockholm, Sir Fraser showed his passion for molecules and stimulating the imagination of the younger generation. Awarding molecular machines with the Nobel Prize honors the outstanding achievements in the art of building the small – from molecular switches to machines. It is only the beginning and it is foreseen that dynamic molecular materials will be fabricated in the future, eventually leading to controlled and engineered out-of-equilibrium behavior. And in that sense, this topic is strongly related to the research focus areas defined for the TU/e leading to 2030: engineering complexity, smart materials as well as the merging of biology and technology. The ICMS foresees great involvement in these areas of science and technology with its many members in the departments of biomedical engineering, chemical engineering, mathematics, mechanical engineering, and applied physics.

NEWS, AWARDS & GRANTS

FIVE FOCAL PROJECTS

selected for FMS

The Research Center for Functional Molecular Systems (FMS), has granted 5 focal projects to strengthen the collaboration between the participating institutes in Groningen, Nijmegen and Eindhoven. All 5 submitted proposals were granted after evaluation by the FMS Scientific Advisory Panel.

The focal projects:

- Compartmentalized catalytic systems for autonomous movement (Wilson (RU), Harutyunyan (RUG) and Voets (TU/e))
- A hybrid metabolic system (Roelfes (RUG) and Palmans (TU/e))
- Supramolecular highways for marching nanocars (Feringa (RUG) and Meijer (TU/e))
- Control of alignment in supramolecular biomaterials; towards complex hierarchy in synthetic extracellular matrices (Kouwer (RU), Sijbesma (TU/e) and Dankers (TU/e))
- Towards 'Living Materials' – Pattern formation and motility in preprogrammed hydrogels (De Greef (TU/e) and Huck (RU))

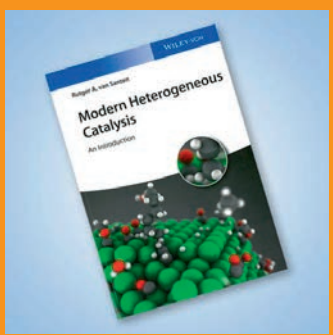
Ilja Voets and team members at

THE DIES NATALIS

Associate Professor in Physical Chemistry dr. Ilja Voets and Emma Giakoumatos & Phil Guo gave some intriguing insights in their research on "Ice-binding proteins and self-organized soft matter" during the Dies Natalis April 20th, 2017 in the Paterschurch in Eindhoven.

New book prof. van Santen

'MODERN HETEROGENEOUS CATALYSIS'



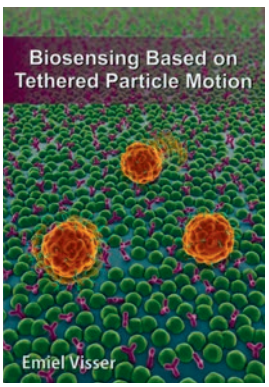
The recent text book 'Modern Heterogeneous Catalysis, an introduction' by Rutger van Santen introduces the molecular and physical chemistry of heterogeneous catalytic reactivity. Computational and spectroscopic advances provide insight in the relation between reaction mechanism and catalyst inorganic chemistry. Currently applied heterogeneous catalytic reactions as well as new biomass conversion, electro catalytic and photocatalytic processes are treated.

THESES ICMS

April 2017 – October 2017

1 **Biosensing based on tethered particle motion**
Emiel Visser

April 19, 2017
PhD advisors:
prof.dr.ir. M.W.J. Prins,
dr. L.J. van Ijzendoorn

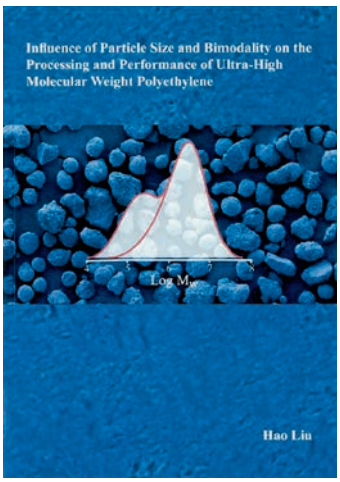


2 **Amide based organic ferroelectrics**
Xiao Meng

May 8, 2017
PhD advisors:
prof.dr. R.P. Sijbesma,
dr. S.C.J. Meskers

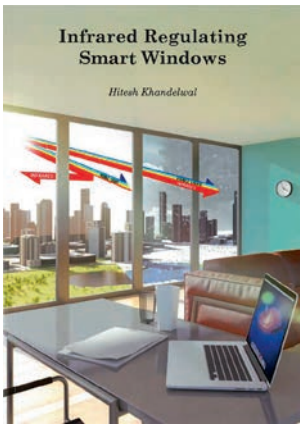
3 **Influence of particle size and bimodality on the processing and performance of ultra-high molecular weight polyethylene**
Hao Liu

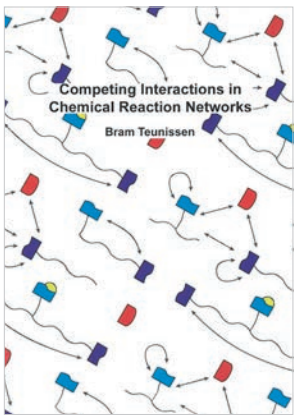
April 26, 2017
PhD advisors:
prof.dr. A.P.H.J. Schenning,
prof.dr.ing. C.W.M. Bastiaansen

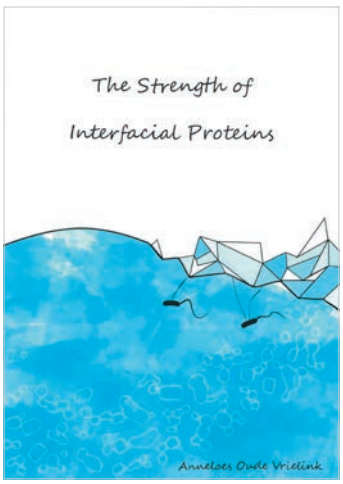


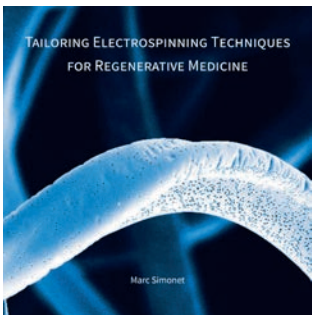
4 **Infrared regulating smart windows**
Hitesh Khandelwal

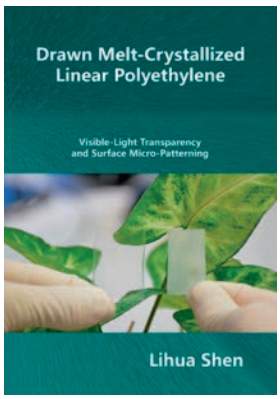
May 11, 2017
PhD advisors:
prof.dr. A.P.H.J. Schenning,
prof.dr. D.J. Broer











5 **Competing interactions in chemical networks**
Bram Teunissen

June 13, 2017
PhD advisors:
prof.dr. E.W. Meijer,
dr. ir. T.F.A. de Greef

6 **The strength of interfacial proteins**
Anneloes Oude Vrielink

July 5, 2017
PhD advisors:
prof.dr. E.W. Meijer,
dr. I.K. Voets

7 **Tailoring electrospinning techniques for regenerative medicine**
Marc Simonet

September 7, 2017
PhD advisors:
prof.dr.ir. F.P.T. Baaijens,
prof.dr.ir. C.W.J. Oomens

8 **Drawn melt-crystallized linear polyethylene visible-light transparency and surface micro-patterning**
Lihua Shen

September 18, 2017
PhD advisors:
prof.dr. A.P.H.J. Schenning,
prof.dr.ing.
C.W.M. Bastiaansen

9 **Supramolecular biomaterials in action – bioactivation through surface modifications**
Olga Goor

September 19, 2017
PhD advisors:
prof.dr. E.W. Meijer,
dr.dr. P.Y.W. Dankers

10 **Large matroids enumeration and typical properties**
Jorn van der Pol

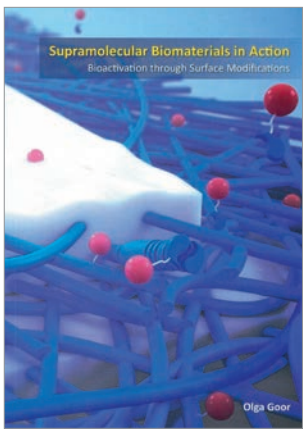
September 20,2017
PhD advisors:
prof.dr. R.W. van der Hofstad,
dr. R.A. Pendavingh

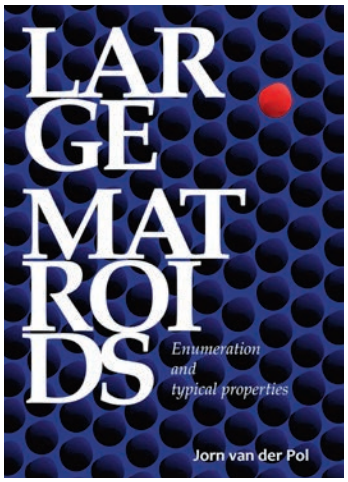
11 **Solution-processed small-molecule organic solar cells**
Qiang (Mike) Wang

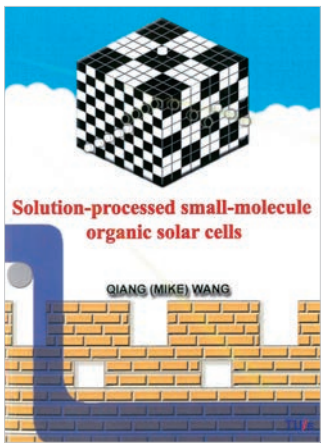
September 28, 2017
PhD advisors:
prof.dr.ir. E.J.M. Janssen,
dr.ir. M.M. Wienk

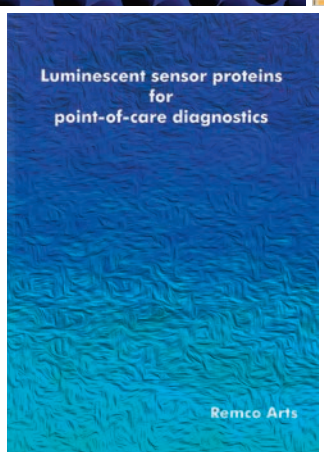
12 **Stabilization of multivalent 14-3-3 protein-protein interactions**
Loes Stevers

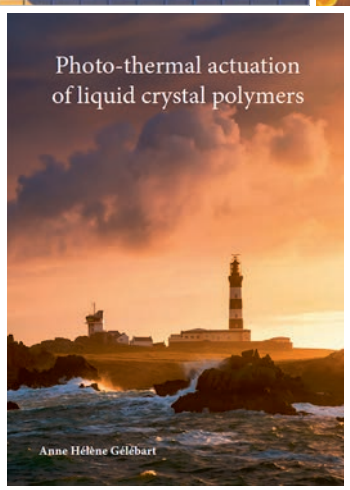
October 10, 2017
PhD advisors:
prof.dr.ir. L. Brunsveld,
dr.rer.nat. C. Ottmann

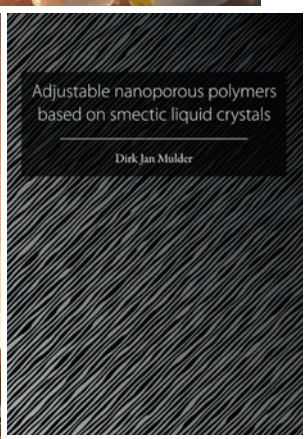












13 **Structured antifouling coatings for the marine environment**
Sander Kommeren

October 19, 2017
PhD advisors:
prof.dr. A.P.H.J. Schenning,
prof.dr.ing. C.W.M. Bastiaansen

14 **Luminescent sensor proteins for point-of-care diagnostics**
Remco Arts

October 23, 2017
PhD advisors:
prof.dr. M. Merkx,
prof.dr.ir. L. Brunsveld

15 **Photo-thermal actuation of liquid crystal polymers**
Anne Hélène Gelebart

October 24, 2017
PhD advisors:
prof.dr. D.J. Broer,
prof.dr. A.P.H.J. Schenning

16 **Adjustable nanoporous polymers based on smectic liquid crystals**
Dirk Jan Mulder

October 24, 2017
PhD advisors:
prof.dr. A.P.H.J. Schenning,
prof.dr. D.J. Broer

Institute for Complex Molecular Systems

New technologies by mastering complexity

Mastering complexity requires a deep understanding on how matter – both natural and artificial – self-organizes into functional molecular systems. The Institute for Complex Molecular Systems, established in 2008, brings together mathematics, physics, biology, chemistry and engineering to stimulate education and research in this emerging field of science. Interdisciplinarity is the core of ICMS; with the input from leading specialists in different branches, new avenues are explored.

Our mission is to be a leading institute for research and education in the engineering of complex molecular systems. We do this via:

- Performing top research
- Training of talented young scientists
- Being the hotspot for interdisciplinary science activities of TU/e
- Foundation and housing of the Advanced Study Center

The scientific agenda consists of three lines of research:

1. Functional molecular systems (program leader prof.dr. Bert Meijer and prof.dr.ir. Jan van Hest)
2. Bio-inspired engineering (program leaders prof.dr.ir. Menno Prins and prof.dr. Patricia Dankers)
3. Complexity Hub (program leaders prof.dr. Rutger van Santen and prof.dr. Mark Peletier)

The research agenda is currently being updated.

ICMS hosts the *Advanced Study Center*. This serves as an intellectual home to scientists from all over the world, hosting discussions on the theme of complexity. It is the home of *Eindhoven Multiscale Institute* (EMI) and *Eindhoven Polymer Laboratories* (EPL).
We aim at offering an ideal training environment for young students and scientists to prepare themselves for a career in science and engineering in a world of increased complexity. Therefore, master and PhD students can participate in *certificate programs*, in addition to their departmental programs. The relationship with industry is strengthened via the *Industrial Consortium* – where science meets innovation.

More information can be found via **www.tue.nl/icms**. Please contact us with specific questions or remarks via icms@tue.nl or +31 40 247 5074.

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Het Parool

Oersoep van Nemo toont ook bouwstenen voor leven

De afgelopen vijf jaar hebben geleerden in Nemo het beroemde Miller-Urey-experiment herhaald, met als belangrijkste resultaat: ook in de Nemoversie hebben zich 'bouwstenen voor leven' gevormd.


Een folie dat vanzelf naar de lamp loopt

Het blijft een wonderlijk gezicht om het over een glasplaatje te zien wandelen

Editorial
ICMS Highlights is published twice a year for ICMS members, colleagues, collaboration partners, policy makers and affiliated companies.

Editorial staff
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(editorial assistant)

Design and print
Echt Marketingcommunicatie, Eindhoven

Illustrations and cover
ICMS Animation Studio

Article contributions
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