

November 2017



Prof. Van der Donk (left)  
and the chair of the Backer  
Foundation Prof. Roelfes

## Backer Lecture 2017

This year, the Backer lecture was presented by Prof. Wilfred A. van der Donk of the University of Illinois at Urbana-Champaign, USA. The lecture was embedded in the Gratama Workshop, a joint 3-days seminar of Japanese and Dutch chemists that takes place every four years. The lecture title of Van der Donk was: Biosynthesis and Engineering of Cyclic Peptide Antibiotics. The lecture was very interesting and scholarly presented. For those of you interested in these peptide antibiotics or “ripps” (ribosomally synthesized and post-translationally modified peptides) please read the work of Van der Donk and as a start look [here](#).



## Molecular Machines Nobel Prize Conference

From November 19<sup>th</sup> to 22<sup>nd</sup> 2017, Groningen and the University will host the [Molecular Machines Nobel Prize Conference](#). The conference is in honour of the 2016 Nobel Laureates in Chemistry, [Prof. J.-P. Sauvage](#), [Prof. J. Fraser Stoddart](#) and [Prof. B.L. Feringa](#), all of whom will participate fully and deliver lectures. The [scientific program](#) celebrates their achievements with top speakers covering the various topics in the fields of research of the laureates. This conference wishes to offer the unique opportunity to learn about the latest developments relating to the 2016 Nobel Prize in Chemistry. The conference social program will culminate in a festive dinner at the Martini Church on November 21st.

## Final Results Research Review 2017

Dear members of the Stratingh institute for Chemistry,

we are pleased to announce that the Stratingh Institute research review ("onderzoeksvisiting") carried out by the QANU (Quality Assurance Netherlands Universities) this year has led to the following result:

**Research quality: excellent**  
**Societal relevance: excellent**  
**Viability: excellent**

in other words the highest possible score. We can be proud!

**Thanks to all of you to help to achieve this outstanding result!**

Adri Minnaard (director)

Cristina D'Arrigo (research manager)



### Unilever Research Prize to Ruben Andringa

Ruben Andringa, PhD student in the Minnaard group since May 2017, has been awarded the Unilever Research Prize.

Just like last year, the Unilever Research Prizes 2017 will be in the spirit of the Global Goals ([www.globalgoals.org](http://www.globalgoals.org)) and Ruben graduation topics interfaces with one or more of these global goals, an important criterion in order to qualify for the Unilever Research Prize. With the annual Unilever Research Awards, Unilever wants to express its appreciation for important scientific research as taught by Dutch universities and hopes that the prize will be seen as an encouragement to further performing high-level scientific research as good research is the basis of groundbreaking innovations. In addition, Unilever emphasizes the importance it attaches to good relations with science and education in the Netherlands.

The impressive nominations received every year for this prize reflect the high quality of Dutch universities which play a vital role in the creation of our future leaders.

This year Unilever organizes for the 61st time a festive presentation of the Unilever Research Prizes. Ruben will collect his prize, € 2500, on Thursday December 7th. The ceremony will take place in the auditorium of Unilever R&D Vlaardingen where Ruben will also present his work with a poster.

### Highlights by Prof. dr. Jan B.F.N.Engberts

- For a quantification and theoretical analysis of the electrophilicities of Michael acceptors, the kinetics of some standard Michael reactions were measured by Mayr and seven coworkers at the Ludwig-Maximilians-University in München. These scientists used monoacceptor-substituted ethylenes and styrenes with pyridinium ylides, a sulfonium ylide, and a sul-

fonyl-substituted chloromethyl anion. These reactions occur via stepwise processes with a common rate-determining step as confirmed by potential energy surface calculations, implying that a single set of electrophilicity parameters (E) for Michael acceptors can be employed to calculate rate constants for ordinary Michael additions, but also for a number of other reactions that occur via a rate-determining formation of the first C-C  $\sigma$ -bond. As claimed by the authors, electrophilicity data are also useful for testing other kinetic models. A particularly interesting finding is the good correlation between electrophilic reactivities and the quantumchemically calculated methyl anion affinities in DMSO solution. The relative reactivities of different families of Michael acceptors should be derived from the thermodynamics of the rate-determining step, and not from orbital interactions of the reactants. *Allgäuer, D.S., Jangra, H., Asahara, H., Li, Z., Chen, Q., Zipse, H., Ofial, A.R., Mayr, H., J.Am.Chem.Soc. 2017, DOI 10.1021/jacs.7b05106.*

- Tubingesin B (T-B) is an indole diterpenoid carrying a disubstituted carbazole unit, five stereogenic centres (three of which are quaternary) and a decorated [3.2.2]-bridged bicycle. The compound has been isolated from a fungus in 1989 and its crystal structure was determined in the same year. Garg and two colleagues from the University of California in Los Angeles, have now described the first concise and enantiospecific total synthesis of T-B that hinges on the strategic use of a transient aryne intermediate. Important key steps are (1) a B-alkyl Suzuki-Miyaura coupling, (2) a carbazole cyclization to construct the seven-membered ring, (3) a Rh-catalyzed fragmentation of a cyclobutenol ring, (4) a radical cyclization to install a final quaternary stereocentre and the [3.2.2]-bridged bicyclic framework of T-B. The study demonstrates that challenging problems in the synthesis of stereospecific natural products might be considered in terms the approaches used in the present study. *Corsello, M.A., Kim, J., Garg, N.K., Nature Chem., 2017, DOI 10.1038/nchem.2801.*
- London dispersion (LD) interactions belong to the fundamental forces between atoms and between molecules. Adequate computational methods have been applied properly to determine the strength of LD interactions in the gas phase. However, similar forces in solution remain to be fully understood, largely because experimental data are still rather sparse. In a detailed computational and experimental (largely NMR) study of the bond dissociation of proton-bound dimers, Chen and four coworkers from the ETH, Zürich, have now compared London LD interactions in the gas phase and in dichloromethane solution. Interestingly, it was observed that LD interactions in solution are weaker by about 70%. As expected, LD becomes very significant for medium-to-large molecules in the gas phase but is accompanied by a significant contribution of repulsive Pauli exchange. In solution, the LD attractive interactions remain relevant for chemical reactions, and altering LD is an important approach to tune molecular stability for chemical processes in solution. It was further shown that the currently employed solvent models are not adequate for quantization of LD in solution, especially in case LD is significant. It seems clear that alternative approaches and models are required for an adequate estimate of the contribution of LD in chemical reactions. *Pollice, R., Bot, M., Kobyljanskii, I.J., Shenderovich, I., Chen, P., J.Am.Chem.Soc. 2017, DOI 10.1021/jacs.7b06997.*
- A manuscript, published by Baran, from the Scripps Institute in La Jolla, USA, and ten coworkers from Research Institutes in Tianjin (China) and Groton, (USA), was characterized by *Angew. Chem.Int.Ed.* as a very important paper. It deals with electrochemically enabled, nickel-catalyzed coupling between aryl (pseudo)halides and aliphatic amines at room temperature, without an external base and employing an inexpensive experimental setup using a constant current and an undivided cell. Important issues are the scalability, functional-group tolerance,

the rapid rate, and the possibility to use a variety of aryl donors (Ar-Cl, Ar-Br, Ar-I and Ar-Tf), amine types (primary and secondary) and sometimes even alternative X-H donors such as alcohols and amides. The procedure represents a rare example in which anodic and cathodic processes provide reactive catalysts in different oxidation states and not involving a sacrificial electrode. Further studies are required to establish the full potential of the present findings. *Li, C., Kawamata, Y., Nakamura, H., Vantourout, J.C., Liu, Z., Hou, Q., Bao, D., Starr, J.T., Chen, J., Yan, M., Baran, P.S., Angew.Chem.Int.Ed., 2017, DOI 10.1002/anie.201707906.*

- Qi, and six coworkers at the Okinawa Institute of Science and Technology in Okinawa, Japan, have shown how the efficiency and stability of organometal halide perovskite solar cells can be improved by engineering their interface structure. They applied a surface modification of the widely used TiO<sub>2</sub> compact layer, which gave insight into interface interactions in these solar cells. Using anatase TiO<sub>2</sub>, a high power conversion efficiency (PCE) was found, but the device degraded rapidly. Also other modifications gave problems, but a simultaneous high PCE and long lifetime could be obtained by employing an insulating polymer interface deposited on top of TiO<sub>2</sub>. The effect of different functional groups on the polymer was examined in some detail for a further understanding of the relation between interface structure and the properties of the solar cells. Not only the band alignment at the interface has to be considered, but also interface chemical interactions between the thin interface layer and the perovskite film. The overall results suggest that the interface interaction between TiO<sub>2</sub> and CH<sub>3</sub>NH<sub>3</sub>PbI<sub>3</sub> have a dominant effect. Further studies based upon the present effects will be useful. *Qiu, L., Ono, L.K., Jiang, Y., Leyden, M.R., Raga, S.R., Wang, S., Qi, Y., J.Phys.Chem.B 2017, DOI 10.1021/acs.jpcc.7b03921.*
- Merner and two coworkers from Auburn University, Auburn, USA, published a non-cross-coupling-based approach to arene-bridged macrocycles which is an alternative to palladium- and nickel-mediated synthetic processes. The novel procedure can allow for the introduction of functional group handles, as, for example, aryl halides, at an early stage in the synthesis of more complex macrocyclic systems. They can be employed at a later stage in the preparation of extended aromatic systems. It is argued that the macrocyclic 1,4-diketone approach has potential advantages for the selective synthesis of functionalized benzenoid macrocycles for future complexity-building reactions. *Mitra, N.K., Merryman, C.P., Merner, B.L., Synlett 2017, DOI 10.1055/s-0036-1589081.*
- In J.Phys.Org.Chem. appeared a paper written by five scientists from the University of Kazan, Russia. Kinetic parameters were measured for the unusual [2π+2σ+2σ]-cycloaddition reactions of quadricyclane (1) with tetracyanoethylene(2), 4-phenyl-1,2,4-triazoline-3,5-dione(3), N-phenylmaleimide(4) and diethyl azodicarboxylate(5). In addition, the enthalpies of the reactions of 1 + 2 were measured calorimetrically in 1,4-dioxane and of 1 + 3 in toluene. These enthalpies were found to be the largest among all cycloadditions with these dienophiles. In addition, solvent effects were studied for the reaction of 1 + 3 in 11 solvents and found to be moderate and rather similar to those of conventional Diels-Alder and ene reactions. An up to 9 orders of magnitude difference in rate constants was observed for the rate constants of 1 with different dienophiles, largely caused by differences in activation enthalpies. It is argued that the reason for these large differences is most likely the fact that the [2π + 2σ + 2σ] reaction rates are highly sensitive to the energy of donor-acceptor interactions between the reactants. *Kiselev, V., Kornilov, D.A., Anikin, O.V., Sedov, I.A., Kononov, A.I., J.Phys.Org.Chem. 2017, DOI 10.1002/poc.3737.*
- It is now well-known that water is usually of main importance in many biological processes.

The exact role that water plays is becoming better understood in recent years. The motion of water molecules within and around a synthetic peptide-amphiphile nanofiber has been studied by Itoh and Aida of the University of Tokyo, Japan, and was found to be significantly different for its core and surface. The molecule consists of a hydrophobic alkyl part and six  $\alpha$ -amino acid residues with a negative charge at its end. It is known to self-assemble into a well-defined charged nanofiber with a core-shell geometry and a 6.7-nm diameter. Using highly sophisticated physical techniques, it was found that water molecules diffuse more slowly in the charged surface region of the nanofibers than in the hydrophobic core. Replacing the original  $\text{Na}^+$  counterions by  $\text{Ca}^{2+}$  ions induces a further decelerations of the water diffusion and also gelation, consistent with the slow water dynamics at the active sites of biomolecules. The water diffusion was much slower at the nanofibre's surface in the gel than in solution. Support for these findings was found using molecular dynamics simulations. Overall the results are in agreement with the notion that slow-diffusing water molecules exist within the active sites of biomolecules such as enzymes and assist guest binding by entropy effects. It seems clear that a better knowledge of water dynamics and hydrophobic effects are crucial for understanding biological processes, and also for practical applications. *Itoh, Y., Aida, T., Nature Chem., 2017, DOI 10.1038/nchem.2870.*

Jan Engberts

## New appointments



Juana Maria Pérez-Galera

PostDoc—group Harutyunyan

1/10/2017



Johannes Klein

Assistant Professor Molecular Inorganic Chemistry

1/10/2017

## PhD defences

### Friday, November 3<sup>rd</sup>

@ 11:00 **Pablo Ortiz** will defend his PhD thesis. Title: “Chemo and enantioselective addition of grignard reagents to ketones and enolizable ketimines”. Promotores: Prof. dr. S. Harutyunyan and Prof. Dr. W.R. Browne

@ 16:15 Manuela Bersellini will defend her PhD thesis. Title: “Artificial control of protein activity”. Promotor: Prof.dr. J.G. Roelfes

### Friday, November 17<sup>th</sup>

@ 14:30 **Jos Kistemaker** will defend his PhD thesis. Title: “Authonomy and Chirality in Molecu-

lar Motors". Promotor: Prof. dr. B.L. Feringa

@ 16:15 **Peter Štacko** will defend his PhD thesis. Title: "Control of Translational and Rotational Movement at Nanoscale". Promotores: Prof. dr. B.L. Feringa and Prof. Dr. W.R. Browne

### **Friday, November 24<sup>th</sup>**

@ 14:30 **Thomas van Leeuwen** will defend his PhD thesis. Title: "On Conformational and Configurational Aspects of Molecular Motors". Promotor: Prof. dr. B.L. Feringa

@ 16:15 **Anouk Lubbe** will defend her PhD thesis. Title: "Molecular Motors in new Media". Promotor: Prof. dr. B.L. Feringa

### **Friday, December 1<sup>st</sup>**

@ 14:30 Stefano Pizzolato will defend his PhD thesis. Title: "Dynamic transfer of chirality in photo-responsive systems. Applications of molecular photoswitches in catalysis". Promotor: Prof. dr. B.L. Feringa

## **Werkbespreking: Thursday morning 8.30 hrs, room 5111.0080**

**November 9<sup>th</sup>—Bin Liu (PhD Otto)** - "Foldamers and self-replicators from aminoacid-nucleobase conjugates"

**November 16<sup>th</sup>—Dowine de Bruijn (PhD Roelfes)** - "Bioorthogonal metal catalysis"

**November 23<sup>rd</sup>—Tilde Pellegrini (PhD Harutyunyan)** - "Asymmetric addition of Grignard reagents to symmetric heteroaryl disubstituted olefines"

**November 30<sup>th</sup>—Dorus Heijnen (PhD Feringa)** - "Advances in organolithium cross coupling reactions"

**December 14<sup>th</sup>—Mira Holzheimer (PhD Minnaard)** - "Total synthesis of the mycobacterial glycolipid DAT2a and its non-natural analogue thio-DAT2a"

## **Stratingh traditional Christmas Borrell—save the date**

The yearly "Christmas borrel" of the Stratingh Institute will take place on Wednesday December 20<sup>th</sup>, 2017. It will start at 16.00 and it will take place in room 5171.0415 (Het Oog), Linnaeusborg.

*If you have items for the next issue of this Newsletter, please send an e mail to the Stratingh Institute office: [Stratingh@rug.nl](mailto:Stratingh@rug.nl)*