

Sino-Belgian Workshop on Supramolecular Chemistry and Catalysis

Organized in the framework of the FWO- research community "Supramolecular Chemistry and Materials"

Venue MTM - Kasteelpark Arenberg 44, 3001 Heverlee, Room 00.39
<http://www.mtm.kuleuven.be/English/AboutUs/Howtofindus>

Programme 27 March, 2017

10.00-10.05 W. Dehaen (KU Leuven) Welcoming address
10.05-10.45 Mei-Xiang Wang (Tsinghua University, Beijing, China) **Corona[n]arenes: New Macrocycles in Supramolecular Chemistry**
10.45-11.25 E. V. Van der Eycken (KU Leuven) **Gold Nanoparticles Catalyzing Spirocyclizations under Microflow Conditions**
11.25-12.05 Chuan-Feng Chen (Chinese Academy of Science, Beijing, CH) **Triptycene-Derived Macrocyclic Hosts for Molecular Recognition and Self-Assembly**
12.20-14.00 Lunch time
14.00-14.45 Hennie Valkenier (ULB, BE) **Transmembrane transport of chloride by synthetic anion carriers**
14.40-15.20 Sanzhong Luo (Chinese Academy of Science, Beijing, CH) **Bio-inspired Small Molecular Catalysis**
15.20-15.50 **Coffee**
15.50-16.30 G. Evano (ULB, BE) **Copper-Catalyzed Radical Reactions**
16.30-17.10 De-Xian Wang (Chinese Academy of Science, Beijing, CH) **Understanding and Application of Anion- π Interactions**
17.10-17.30 W. Dehaen (KU Leuven, BE) **Heteracalixarenes@KULeuven : Past, Present and Future**
After 17.30 A small walk from the workshop venue (>10 min) and a visit to the new facilities of Chem & Tech, followed by a reception (first floor)

Participation is free but please register by sending a mail to mathias.daniels@kuleuven.be

Lunch can be taken at one of the nearby restaurants or cafeterias

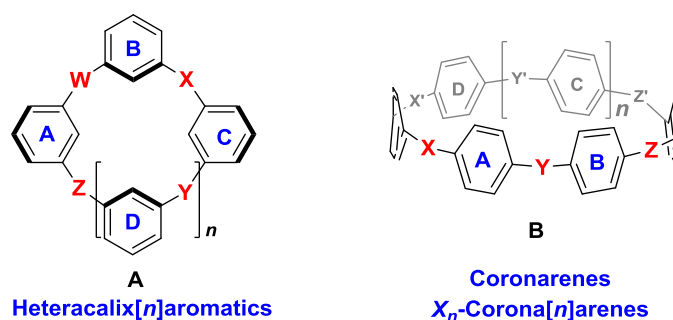
Corona[n]arenes: New Macrocycles in Supramolecular Chemistry

Mei-Xiang Wang

Department of Chemistry, Tsinghua University, Beijing, 100084

wangmx@mail.tsinghua.edu.cn

Novel and functional macrocyclic molecules play a key role in the establishment and development of supramolecular chemistry. For more than a decade, we have been exploring the macrocyclic and supramolecular chemistry of heteracalixaromatics A.^{1,2} Owing to the self-tunability of a V-shaped cavity and electronic property by the interplay between the bridging heteroatoms and adjacent aromatic rings, heteracalixaromatics exhibit unique binding properties and have become powerful and versatile synthetic receptors to recognize diverse charged and electron neutral guest species.²⁻⁵ To seek for novel and functional macrocyclic hosts that have a cylindroid cavity, we have very recently proposed corona[n](het)arenes B, a new type of synthetic macrocycles which are composed of heteroatoms and para-(het)arylenes in an alternative fashion.⁶ This lecture will focus on the design and the synthesis of diverse functionalized corona[n]arenes followed by the interesting conformational structures. Host-guest chemistry of some corona[n]arenes will also be discussed.



References

- (a) M.-X. Wang, H.-B. Yang, *J. Am. Chem. Soc.* **2004**, *126*, 15412. (b) M.-X. Wang, X.-H. Zhang, Q.-Y. Zheng, *Angew. Chem. Int. Ed.* **2004**, *43*, 838.
- (a) M.-X. Wang, *Acc. Chem. Res.* **2011**, *45*, 182. (b) M.-X. Wang, *Chem. Commun.* **2008**, 4541. (c) Maes, W.; Dehaen, W. *Chem. Soc. Rev.* **2008**, *37*, 2393. (d) Tsue, H.; Ishibashi, K.; Tamura, R. *Top. Heterocycl. Chem.* **2008**, *17*, 73. (e) Morohashi, N.; Narumi, F.; Iki, N.; Hattori, T.; Miyano, S. *Chem. Rev.* **2006**, *106*, 5291.
- (a) C.-Y. Gao, L. Zhao, M.-X. Wang, *J. Am. Chem. Soc.* **2012**, *134*, 824. (b) C.-Y. Gao, L. Zhao, M.-X. Wang, *J. Am. Chem. Soc.* **2011**, *133*, 8448.
- (a) D.-X. Wang, Q.-Y. Zheng, Q.-Q. Wang, M.-X. Wang, *Angew. Chem. Int. Ed.* **2008**, *47*, 7485. (b) D.-X. Wang, Q.-Q. Wang, Y. Han, Y. Wang, Z.-T. Huang, M.-X. Wang, *Chem. Eur. J.* **2010**, *16*, 13053. (c) D.-X. Wang, M.-X. Wang, *J. Am. Chem. Soc.* **2013**, *135*, 892.
- (a) B. Yao, D.-X. Wang, Z.-T. Huang, M.-X. Wang, *Chem. Commun.* **2009**, 2899. (b) H. Zhang, B. Yao, L. Zhao, D.-X. Wang, B.-X. Xu, M.-X. Wang, *J. Am. Chem. Soc.* **2014**, *136*, 6326.
- (a) Q.-H. Guo, Z.-D. Fu, L. Zhao, M.-X. Wang, *Angew. Chem. Int. Ed.* **2014**, *53*, 13548. (b) Q.-H. Guo, L. Zhao, M.-X. Wang, *Angew. Chem. Int. Ed.* **2015**, *54*, 8386. (c) W.-S. Ren, L. Zhao, M.-X. Wang, *Org. Lett.* **2016**, *18*, 3126. (d) Z.-D. Fu, Q.-H. Guo, L. Zhao, D.-X. Wang, M.-X. Wang, *Org. Lett.* **2016**, *18*, 2668. (e) Q.-H. Guo, L. Zhao, M.-X. Wang, *Chem. Eur. J.* **2016**, *22*, 6947.

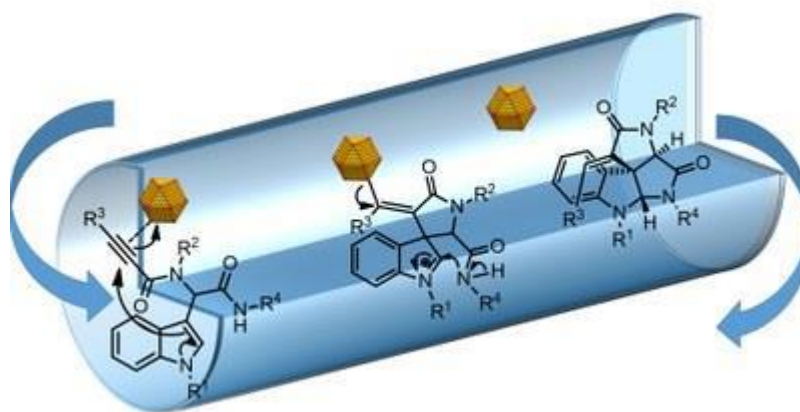
Gold Nanoparticles Catalyzing Spirocyclizations under Microflow Conditions

Erik V. Van der Eycken

University of Leuven (KU Leuven), Celestijnenlaan 200F, Leuven, B-3001, Belgium

erik.vandereycken@kuleuven.be

Gold catalysis utilizing supported gold nanoparticles is an emerging topic in the intensively studied domain of gold-catalyzed reactions. Supported gold nanoparticles combine the advantageous features of homo- and heterogeneous catalysis by merging the selective activation of π -systems with an uncomplicated recycling of the catalyst. Therefore, they provide opportunities to facilitate the application of gold catalysis on a larger scale. Nonetheless, in order to allow an application on an industrial scale, gold-catalyzed processes must be improved with regard to cost, productivity, robustness and environmental sustainability. A logical solution to overcome such issues is the use of a continuous-flow process utilizing highly active supported gold nanoparticles in a packed-bed reactor. The combination of heterogeneous gold catalysis with microreactor technology offers various advantages compared to batch processes.



Besides apparent benefits such as enhanced mixing, improved heat transfer, and safer reaction conditions, the use of a packed-bed reactor can increase selectivity and facilitate challenging transformations. Under continuous-flow conditions, usually short residence times are observed due to the increased amount of catalyst/reactant in the packed bed, resulting in less degradation of sensitive substrates. Moreover, the use of a catalyst bed facilitates catalyst recycling and reuse, thereby reducing the amount of metal impurities in the final product. Recently, our international group developed a novel heterogeneous gold catalyst, consisting of gold nanoparticles on an Al-SBA15 support, for post-Ugi cycloisomerizations. The reaction enabled rapid and efficient access to various spiroindolines. In terms of reactivity, selectivity and productivity, the reported protocol proves to be superior to previous reports. The main reason for the superiority is the very high catalyst to substrate ratio in the packed-bed reactor. Moreover no detectable leaching of the Au@Al-SBA15 catalytic bed was noted.

Literature:

- F. Schröder, M. Ojeda, N. Erdmann, J. Jacobs, R. Luque, T. Noël, L. Van Meervelt, J. Van der Eycken, E. V. Van der Eycken, *Green Chem.* 2015, 17, 3314-3318.
- F. Schröder, N. Erdmann, T. Noël, R. Luque, E. V. Van der Eycken, *Adv. Synth. Catal.* 2015, 357, 3141-3147.
- F. Schröder, U. Sharma, M. Mertens, F. Devred, D. Debecker, R. Luque, E. V. Van der Eycken, *ACS Catalysis*, 6, 8156-8161, 2016.

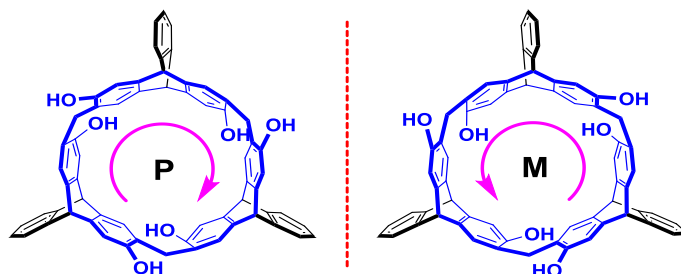
Triptycene-Derived Macrocyclic Hosts for Molecular Recognition and Self-Assembly

Chuan-Feng Chen

CAS Key Laboratory of Molecular Recognition and Function, Institute of Chemistry, Chinese Academy of Sciences, Beijing 100190, China

cchen@iccas.ac.cn

The development of novel macrocyclic hosts with the capability of binding substrate species strongly and selectively is always a permanent and important topic in host-guest chemistry, and also supramolecular chemistry. During the last decade, we have developed several different kinds of triptycene-derived macrocyclic hosts, and explored their applications in molecular recognition and self-assembly.^{1,2} Recently, we have designed and synthesized a new class of chiral macrocyclic arenes composed of three 2,6-dihydroxytriptycene subunits bridged by methylene groups. The crystal structure showed that the macrocycle adopts a hex nut-like structure with a helical chiral cavity, which we named 2,6-helic[6]arene. Efficient resolution was then performed by the introduction of chiral auxiliaries to give a couple of enantiopure macrocycles, which exhibited highly enantioselective recognitions towards three pairs of chiral compounds containing a trimethylamino group.^{3a} Moreover, the 2,6-helic[6]arene and its derivatives also showed high affinities towards various organic cationic guests, and even neutral electron-deficient molecules.^{3b-c} In this lecture, some of our recent results in the synthesis of triptycene-derived macrocyclic hosts and their applications in molecular recognition and self-assemblies will be presented.



References

- (a) Chen, C.-F.; Ma, Y.-X. *Iptycene Chemistry: From Synthesis to Applications*. Springer-Verlag, Berlin Heidelberg, 2013; (b) Chen, C.-F. *Chem. Commun.* **2011**, 47, 1674-1688; (c) Han, Y.; Meng, Z.; Ma, Y.-X.; Chen, C.-F. *Acc. Chem. Res.* **2014**, 47, 2026-2040.
- (a) Meng, Z.; Han, Y.; Wang, L.-N.; Xiang, J.-F.; He, S.-G.; Chen, C.-F. *J. Am. Chem. Soc.* **2015**, 137, 9739-9745; (b) Meng, Z.; Chen, C.-F. *Chem. Commun.* **2015**, 51, 8241-8244; (c) Meng, Z.; Xiang, J.-F.; Chen, C.-F. *J. Am. Chem. Soc.* **2016**, 138, 5652-5658.
- (a) Zhang, G.-W.; Li, P.-F.; Meng, Z.; Wang, H.-X.; Han, Y.; Chen, C.-F. *Angew. Chem., Int. Ed.* **2016**, 55, 5304-5308; (b) Zhang, G.-W.; Li, P.-F.; Wang, H.-X.; Han, Y.; Chen, C.-F. *Chem. Eur. J.* **2017**, in press; (c) Zhang, G.-W.; Shi, Q.; Chen, C.-F. *Chem. Commun.* **2017**, accepted.

Transmembrane transport of chloride by synthetic anion carriers

Hennie Valkenier^{1,2}

¹ School of Chemistry, University of Bristol, Bristol BS8 1TS, United Kingdom.

² Engineering of Molecular Nanosystems, Université libre de Bruxelles, Av. Franklin Roosevelt 50, 1050 Bruxelles, Belgium.

Hennie.Valkenier@ulb.ac.be

Absence or malfunction of membrane proteins forming anion channels is the cause of several channelopathies, like *cystic fibrosis*. Synthetic anion carriers^[1] have the potential to take over part of the function of these proteins and to cure the symptoms of these diseases. Examples of anion carriers are the cholic acid or trans-decalin based structures with preorganized urea or thiourea groups to bind chloride (Fig.1a). We have recently reported several new chloride carriers that are at least ten times faster than previously reported structures and reach rates of transport up to 850 Cl⁻/s by a single carrier.^[2] Important factors in the development of anion carriers are their affinities for anions and their lipophilicity, but advantage can be also taken of the particular structure of macrocycles to find corresponding selectivities.^[3]

A series of our anion carriers has also been tested in epithelial cells that were engineered to express yellow fluorescent protein (YFP), which can be used as a fluorescent probe to monitor halide concentrations in the cells. Significant anion transport in these cells was found for several of the carriers.^[4] Further experiments confirmed that a low dose of the most active compound is able to restore about half of the current that arises from chloride transport by CFTR, the membrane protein that is absent or malfunctioning in *cystic fibrosis* patients, which makes it a promising therapeutic.

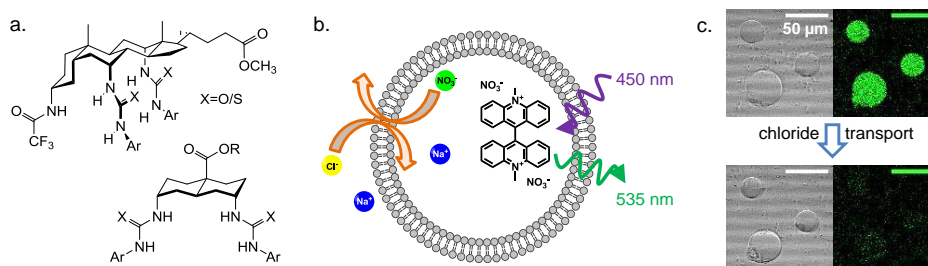


Figure 1a. Anion transporters based on a cholic acid or trans-decalin scaffold, **b.** Schematic representation of chloride transport into a vesicle loaded with lucigenin. Chloride transported into the vesicle quenches the fluorescence of lucigenin, **c.** as visualized by confocal fluorescence microscopy in Giant Unilamellar Vesicles.^[2]

References

- [1] J. T. Davis, O. Okunola and R. Quesada, *Chem. Soc. Rev.*, **2010**, 39, 3843–3862; P. A. Gale, N. Busschaert, C. J. E. Haynes, L. E. Karagiannidis and I. L. Kirby, *Chem. Soc. Rev.*, **2014**, 43, 205–241; H. Valkenier and A. P. Davis, *Acc. Chem. Res.*, **2013**, 46, 2898–2909.
- [2] H. Valkenier, L. W. Judd, H. Li, S. Hussain, D. N. Sheppard and A. P. Davis, *J. Am. Chem. Soc.*, **2014**, 136, 12507–12512; H. Valkenier, N. López Mora, A. Kros, and A. P. Davis, *Angew. Chem. Int. Ed.*, **2014**, 54, 2137–2141.
- [3] S.J. Edwards, H. Valkenier, N. Busschaert, P.A. Gale, A.P. Davis, *Angew. Chem. Int. Ed.* **2015**, 54, 4592; S. J. Edwards, I. Marques, C. M. Dias, R. A. Tromans, N. R. Lees, V. Félix, H. Valkenier, A. P. Davis, *Chem. Eur. J.* **2016**, 22, 2004–2011; M. Lisbjerg, H. Valkenier, B.M. Jessen, H. Al-Kerdi, A.P. Davis, M. Pittelkow, *J. Am. Chem. Soc.* **2015**, 137, 4948.
- [4] H. Li, H. Valkenier, L. W. Judd, P. R. Brotherhood, S. Hussain, J. A. Cooper, O. Jurček, H. A. Sparkes, D. N. Sheppard, A. P. Davis, *Nat. Chemistry* **2016**, 8, 24-32.

Bio-inspired Small Molecular Catalysis

Sanzhong Luo

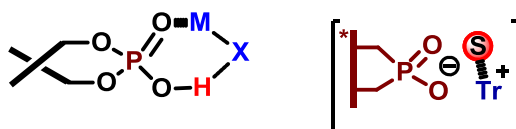
Institute of Chemistry, Chinese Academy of Sciences, Beijing, 100190

luosz@iccas.ac.cn

To develop new catalysts/ligands with superior performance and broad applicability remains a central theme in asymmetric catalysis. Inspired by Nature, we have developed bio-inspired small molecular catalysts as both functional and mechanistic enzyme mimics,¹ showing unprecedented scopes in fundamental transformations of carbonyls and olefins.^{2,3} This type of catalysts have also demonstrated power in synergistically combining with other types of catalytic processes. In this talk, I'll present our recent advances along this line.



Chiral Primary Amine Catalysis



Chiral binary-acid catalysis

References

- (a) Zhang, L.; Luo, S. *Acc. Chem. Res.* **2015**, *48*, 986. (b) Zhang, L.; Luo, S. Z. *Synlett* **2012**, 1575-1589. (c) Lv, J.; Luo, S. Z. *Chem. Commun.* **2013**, *49*, 847. (d) Qin, Y.; Zhu, L.; Luo, S. Z. *Chem. Rev.* **2017**, DOI: 10.1021/acs.chemrev.6b00657.
- Chiral Primary Amine Catalysts: (a) Xu, H.; Fu, N.; Zhang, L.; Li, J.; Luo, S.; Cheng, J.-P. *Angew. Chem. Int. Ed.* **2011**, *50*, 11451; (b) Zhu, Y.; Zhang, L.; Luo, S. *J. Am. Chem. Soc.* **2016**, *138*, 3978; (c) Zhou, H.; Zhang, L.; Luo, S. Z. *Angew. Chem. Int. Ed.* **2015**, *54*, 12645; (d) Zhang, Q.; Cui, X.; Zhang, L.; Luo, S. Z.; Wang, H.; Wu, Y. *Angew. Chem. Int. Ed.* **2015**, *54*, 5210; (e) Zhu, Y.; Zhang, L.; Luo, S. Z. *J. Am. Chem. Soc.* **2014**, *136*, 14642; (f) Xu, C.; Zhang, L.; Luo, S. Z. *Angew. Chem. Int. Ed.* **2014**, *53*, 4149. (g) Yang, Q.; Zhang, L.; Ye, C.; Luo, S. Z.; Wu, L.-Z.; Tung, C.-H. *Angew. Chem. Int. Ed.* **2017**, DOI: 10.1002/anie.201700572. (h) You, Y.; Zhang, L.; Luo, S. Z. *Chem. Sci.* **2017**, *8*, 621.
- Chiral Binary Acid Catalysis: (a) Lv, J.; Zhang, L.; Zhou, Y.; Nie, Z.; Luo, S. Z.; Cheng, J.-P. *Angew. Chem. Int. Ed.* **2011**, *50*, 6610-6614. (b) Lv, J.; Zhang, L.; Luo, S. Z.; Cheng, J.-P. *Angew. Chem. Int. Ed.* **2013**, *52*, 9786-9790; (c) Lv, J.; Zhang, Q.; Zhong, X.; Luo, S. Z. *J. Am. Chem. Soc.*, **2015**, *137*, 15576-15583.

Copper-Catalyzed Radical Reactions

Gwilherm EVANO

*Laboratory of Organic Chemistry – Université libre de Bruxelles,
Avenue F. D. Roosevelt 50 – 1050 Brussels - Belgium*

gevano@ulb.ac.be - <http://chimorg.ulb.ac.be/>

Organic radical chemistry, which dates back over 115 years, has considerably evolved over the past decade and has been recently reignited, as documented by the increasing number of discoveries and reports in this area. Importantly, and quite remarkably, this notably resulted in a much broader utilization of radical processes, both in academia and industry.

Several key parameters can account for this renaissance of synthetic radical chemistry, such as the development of methods enabling the generation of radical species – classically prepared by homolysis of organic halides or xanthates – from less conventional functional groups, and the introduction of new methods, often based on metal catalysis, to initiate or catalyze radical transformations.

In this perspective, we have recently developed various broadly applicable copper-based (photo)catalytic systems enabling the generation of radical species from a wide range of organic halides. These readily available, user-friendly systems have been used for the design of a series of radical reactions including cross-coupling, cyclization and C-H bond functionalization reactions that will be discussed in this presentation.

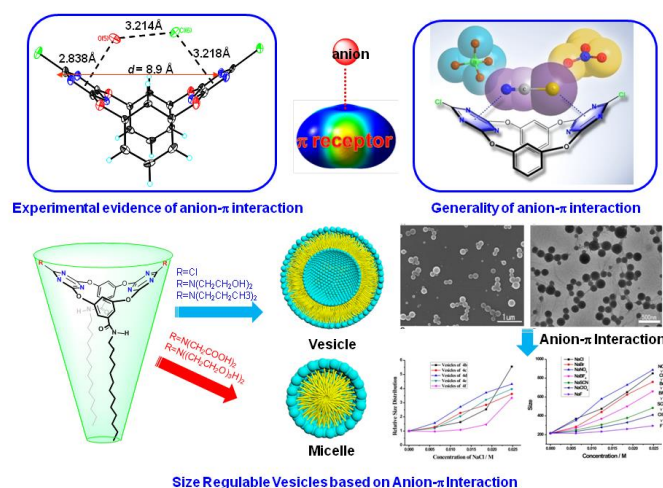
Understanding and Application of Anion- π Interactions

De-Xian Wang

CAS Key Laboratory of Molecular Recognition and Function, Institute of Chemistry, Chinese Academy of Sciences, Beijing 100190, China

dxwang@iccas.ac.cn

Anion- π interactions are a new emerging type of non-covalent motifs describing the interaction between electron rich anions and electron deficient aromatics.¹ Since the former theoretical works that predict such non-covalent interactions,² experimental results both in solid state and solution have exemplified the existence of anion- π interactions.³ Anion- π interactions have recently been widely studied as new non-covalent driving forces in supramolecular chemistry. However, in comparison with the well studied cation- π interaction, which has been successfully applied in biological system and chemistry, the applications of anion- π interactions in supramolecular remains largely unexplored.⁴ Here we will present the structure, generality and application of anion- π interactions.



References

- (a) Frontera, A.; Gamez, P.; Mascal, M.; Mooibroek, T. J.; Reedijk, J. *Angew. Chem. Int. Ed.* **2011**, *50*, 9564-9583; (b) Chifotides, H. T.; Dunbar, K. R. *Acc. Chem. Res.* **2013**, *46*, 894-906; (c) Hay, B. P.; Bryantsev, V. S. *Chem. Commun.* **2008**, 2417-2428; (d) Wang, D.-X.; Wang, M.-X. *Chimia*, **2011**, *65*, 939-943; (e) Ballester, P. *Acc. Chem. Res.* **2013**, *46*, 874-884.
- (a) Mascal, M.; Armstrong, A.; Bartberger, M. D. *J. Am. Chem. Soc.* **2002**, *124*, 6274-6276; (b) Quinero, D.; Garau, C.; Rotger, C.; Frontera, A.; Ballester, P.; Costa, A.; Deya, P. M. *Angew. Chem. Int. Ed.* **2002**, *41*, 3389-3392; (c) Alkorta, I.; Rozas, I.; Elguero, J. *J. Am. Chem. Soc.* **2002**, *124*, 8593-8598.
- (a) Wang, D.-X.; Zheng, Q.-Y.; Wang, Q.-Q.; Wang, M.-X. *Angew. Chem. Int. Ed.* **2008**, *47*, 7485-7488; (b) Wang, D.-X.; Wang, M.-X. *J. Am. Chem. Soc.* **2013**, *135*, 892-897; (c) Rosokha, Y. S.; Lindeman, S. V.; Rosokha, S. V.; Kochi, J. K. *Angew. Chem. Int. Ed.* **2004**, *43*, 4650-4652.
- (a) Gorteau, V.; Bollot, G.; Mareda, J.; Perez-Velasco, A.; Matile, S. *J. Am. Chem. Soc.* **2006**, *128*, 14788-14789; (b) He, Q.; Han, Y.; Wang, Y.; Huang, Z.-T.; Wang, D.-X. *Chem. Eur. J.* **2014**, *20*, 7486-7491; (c) He, Q.; Huang, Z.-T.; Wang, D.-X. *Chem. Commun.* **2014**, *50*, 12985-12988; (d) He, Q.; Ao, Y.-F.; Huang, Z.-T.; Wang, D.-X. *Angew. Chem. Int. Ed.* **2015**, *54*, 11785-11790.

Heteracalixarenes@KULeuven : Past, Present and Future

W. Dehaen

Department of Chemistry, University of Leuven, Leuven, Belgium.

wim.dehaen@chem.kuleuven.be

In previous work, novel oxacalix[m]arene[m]pyrimidines have been synthesized by SNAr reactions on halogenated pyrimidine building blocks [1]. We also reported concerning the functionalisation of the pyrimidine rings [2] and the selective synthesis of calix[6]arene or calix[8]arene derivatives. [3] The periphery of the calix[4]arene analogues can be easily substituted, leading to applications as anion or fullerene receptors.[4] In a next part of the lecture, we will discuss the synthesis of sulfur- and selenium-containing homoheteracalixarenes, again using the nucleophilic substitution reaction, this time of thiolates and selenolates and benzylic halide building blocks.^{6,7}

The expanded homoheteracalixarenes, having additional heteroatoms connecting the (het)arene rings are a class of macrocycles that have been studied a lot less than their counterparts with simple methylene bridges. We have studied several approaches towards sulfur- and selenium-containing homoheteracalixarenes, either starting from phenyl or heterocyclic building blocks. In one approach, nucleophilic substitution of electrophilic arenes and sulfide or selenide nucleophiles, led to macrocycles of different sizes.

Another approach is the oxidative coupling of a single bithiol or bisselenide component, leading to the selective formation of homodiheteracalixarenes. Interestingly, a dithiapillararene-like structure could be obtained in this way. The solid state structure of several of the novel macrocycles has been characterized by X-ray crystallography.[6] Some of the compounds have interesting properties as reversible host materials for small molecules in the solid state.[7]

Current work in the group involves the formation of heteracalixarene structures involving 1,4-benzoquinone building blocks, and the formation and functionalization of larger thiacalixarenes. The application of the triazolization reaction to calixarene chemistry will be briefly discussed.

References

- [1] Maes, Van Rossom, Dehaen et al., W. *Org. Lett.* **2006**, 8, 4161
- [2] Van Rossom, Maes, Dehaen, et al. *Org. Lett.* **2008**, 10, 585-8.
- [3] Van Rossom, Dehaen, Maes et al. ; *Org. Lett.* **2009**, 11, 1681-1684; *Eur. J. Org. Chem.* **2010**, 4122-4198; W. *Org. Lett.* **2011**, 13, 126-129; Van Rossom, Lhotak, Dehaen, Maes et al. *Tetrahedron Lett.*, **2010**, 51, 2423-2426 ; Van Rossom, Maes., Dehaen et al.. *J. Org. Chem.* **2012**, 77, 2797-2797.
- Thomas, Maes, Dehaen et al., W. *Org. Lett.* **2009**, 11, 3040-3043;
- [4]Thomas, Van Rossom., Sonawane, Maes, Dehaen et al. *Chem. Eur. J.* **2011**, 17, 10339-10349; Sonawane, Thomas, Van Rossom, Dehaen, et al. *J.Org. Chem.* **2012**, 8444-8450; Thomas, Van Rossom, Maes, Dehaen et al.. *Chem. Commun.* **2012**, 48, 43-45; *Eur. J. Org. Chem.* **2013**, 2085-2090
- [5] Thomas, Maes, Robeyns, Ovaere, Van Meervelt, Smet, Dehaen, *Org. Lett.* **2009**, 11, 3040; Thomas, Van Hecke, Robeyns, Van Rossom, Sonawane, Van Meervelt, Smet, Maes, Dehaen, *Chem. Eur. J.* **2011**, 17, 10339-10349.
- [6] Sonawane, Jacobs, Thomas, Van Meervelt, W. Dehaen, *Chem. Commun.* **2013**, 49, 6310-6312.
- [7]Thomas, Reekmans, Adriaensens, Van Meervelt, Smet, Maes, Dehaen, Dobrzanska *Angew. Chem. Int. Ed.* **2013**, 52, 10237-10240; Thomas, Dobrzanska, Van Meervelt, Quevedo, Wozniak, Stachowicz, Smet, Maes, Dehaen, *Chem. Eur. J.* **2016**, 22, 979-987.