CiQUS Lecture

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Supramolecular approaches
for gene delivery and catalysis in living cells

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PO FEDER Galicia 2014-202 - *Unha maneira de facer Europa*

Friday, September 23, 2022
5:00 pm CiQUS Seminar Room

Homogeneous and supramolecular catalysis | Van 't Hoff Institute for Molecular Sciences
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Abstract:

The interface between supramolecular chemistry and transition metal catalysis has received surprisingly little attention in contrast to the individual disciplines. It provides, however, novel and elegant strategies that lead to new tools for the search of effective catalysts, and as such this has been an important research theme in our laboratories.[1] In this context we have intensively explored the use of well defined nanospheres[2,3] that form by self-assembly in transition metal catalysis. These nanospheres create catalysts (and substrates) at high local concentration, just like in enzymes, higher reaction rates are observed for several reactions that operate via binuclear mechanism. Also, they provide new tools to control catalytic events in complex media. More recently we have translated the chemistry from the typical organic solvents to aqueous media and biorelevant conditions. This allows to used these nanostructure for new functions as gene delivery and nonnatural catalytic conversions in living cells. This lecture will discuss some of these later results in more detail.

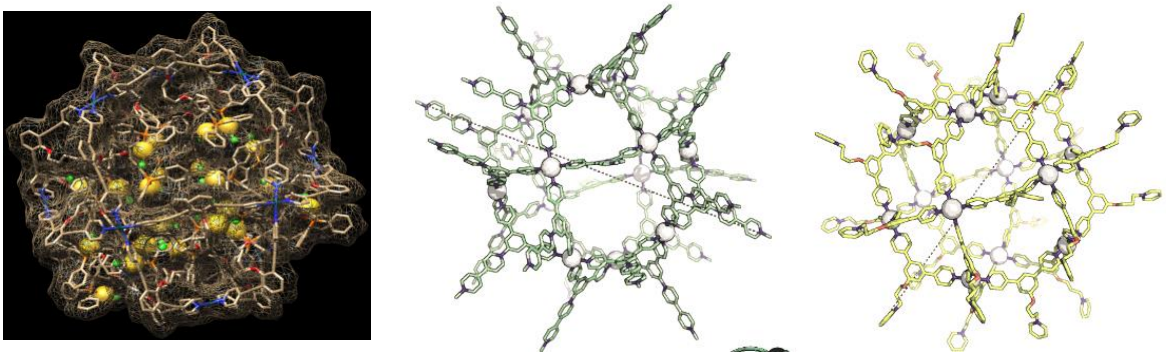

Figure 1: Three examples of functionalized nanospheres for catalysis and for gene delivery.

[1] For reviews see: 1) Reek et al, *Nature Chemistry,* **2010,** *2*, 615. 2) Reek et al, *Chem. Soc. Rev,* **2015**, *44,* 433 – 448 3) *Chem. Soc. Rev.* **2008**, *37*, 247. 4) Reek et al., *Acc. Chem. Res.* **2018**, *51*, 2115. 5) *ACS Catal.* **2018**, *8*, 3469. 6) *ChemAsianJ*. **2021**,*16*, 3851. 7) *Chem. Sci*., **2021**, *12*, 50

[3] Pioneering work on nanospheres: Fujita, etal. 1) *Angew. Chem. Int. Ed.* **2004,** *43*, 5621 2) *Science* **2010**, *328*, 1144 3) *Chem. Commun.* **2009***, 13*, 1638. 4) J.P Stang et al. J. *Am. Chem. Soc.* **1999***, 121*, 10434.

[3] For our work on nanospheres: 1) J.N.H. Reek et al., "*Nature Chemistry*, **2016** *8*, 225-230; 2) *Angew. Chem., Int. Ed.,* **2014,** *52,* 13380; 3) *Angew. Chem., Int. Ed.,* **2018,** *57,* 11247; 4) *Chem. Sci.,* **2019**,*10*, 1316. 5) *J. Am. Chem. Soc.* **2020,** *142* (19), 8837.

Biosketch:

Joost Reek is full professor (chair supramolecular catalysis)since 2006, and distinguished faculty professor since 2017 at the University of Amsterdam. He is co-founder (and currently scientific director) of InCatT (innovative catalyst technologies), a spin-off company that was launched in 2009, and since 2016 he is the scientific director of NIOK. In 2013 he was elected as a new member of the Royal Holland Society of Sciences and Humanities (KHMW), and in 2015 he was elected member of the KNAW (Royal Dutch academy of sciences). With around 400 scientific papers published on different topics, mostly related to catalysis, he has reached a H-index of 78. He has given many invited lectures including the Troisième cycle (Switserland, 2007), the DSM-lecture at the ICOMC (Rennes, 2008) the Erdtman Lecture in 2009, the molecular science frontier lecture of ICCAS (Chinese academy of science) in 2018, the IFOC lectureship award (Japan 2018), JSPS lecture fellowship (Japan 2018) and the Earl Muetterties Lecturer at Berkeley (USA, 2019)

The research performed in the past 20 years is broadly centered around homogenous catalysis and supramolecular chemistry. We develop new catalytic processes based on 1) rational ligand design in transition metal catalysis 2) Supramolecular catalysis 3) Bio-inspired catalysis. We study crucial aspects of catalysis, including activity, selectivity, stability and recycle-ability of the catalyst. In the past 10 years, part of the research has been focused on solar to fuel devices based on molecular components. In this context, we developed new catalyst for water oxidation and proton reduction, and we can drive these uphill reactions using light as the energy source by combining them with the proper chromophores. We are currently also exploring the use of some of our supramolecular concepts including cages for catalysis, for application in living cells.