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Self-assembled molecular cages for transition metal catalysis and applications in living cells

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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 use these nanostructure for new functions as gene delivery and nonnatural catalytic conversions in living cells.[4] In this lecture I will outline the strategies in catalysis and discuss the application in cells for potential cancer treatment and gene delivery, with a focus on the general concepts and most recent results.

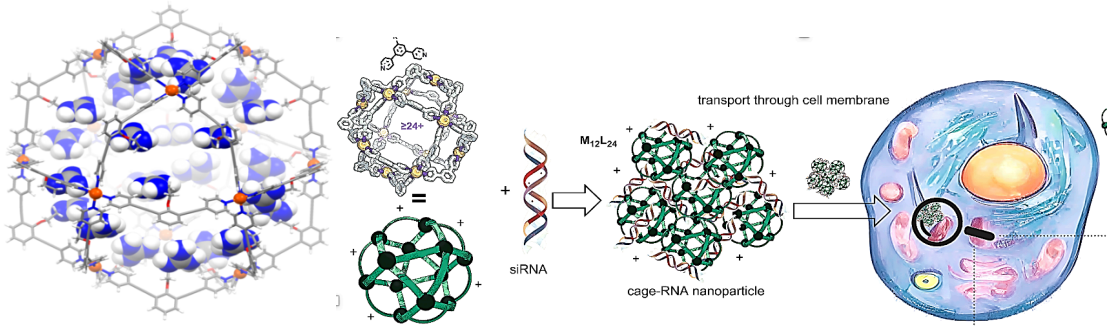

Figure 1: An example of a M12L24 nanosphere as scaffold to bind catalysts (left) and functionalized nanospheres for gene delivery (right)

References

1. For reviews see: a) Reek et al, *Nature Chemistry,* **2010,** *2*, 615. b) Reek et al, *Chem. Soc. Rev,* **2015**, *44,* 433 – 448 c) Reek et al *Chem. Soc. Rev.* **2008**, *37*, 247. d) Reek et al., *Acc. Chem. Res.* **2018**, *51*, 2115. e) Reek et al *ACS Catal.* **2018**, *8*, 3469. f) Reek et al *ChemAsianJ.* **2021**,*16*, 3851. g) Reek et al *Chem. Sci*., **2021**, *12*, 502.
2. Pioneering work on nanospheres: Fujita, etal. a) *Angew. Chem. Int. Ed.* **2004,** *43,* 5621 b) *Science* **2010**, *328*, 1144 c) *Chem. Commun.* **2009**, *13*, 1638. d) J.P Stang et al. J. *Am. Chem. Soc.* **1999**, *121*, 10434.
3. For some of our work on nanospheres a) Reek et al., "*Nature Chemistry*, **2016** *8*, 225-230; b) Reek et al *Angew. Chem., Int. Ed.,* **2014,** *52,* 13380; c) Reek et al *Angew. Chem., Int. Ed.,* **2018,** *57,* 11247; d) Reek et al *Chem. Sci.,* **2019**,*10*, 1316. e) Reek et al *J. Am. Chem. Soc.* **2020,** *142* (19), 8837.f) Reek et al *J. Am. Chem. Soc.* **2022**, *144,* 15633
4. Reek et al *Chem* **2023**, in press https://doi.org/10.1016/j.chempr.2023.03.018

References

1. For reviews see: a) Reek et al, *Nature Chemistry,* **2010,** *2*, 615. b) Reek et al, *Chem. Soc. Rev,* **2015**, *44,* 433 – 448 c) Reek et al *Chem. Soc. Rev.* **2008**, *37*, 247. d) Reek et al., *Acc. Chem. Res.* **2018**, *51*, 2115. e) Reek et al *ACS Catal.* **2018**, *8*, 3469. f) Reek et al *ChemAsianJ*. **2021**,*16*, 3851. g) Reek et al *Chem. Sci*., **2021**, *12*, 502.
2. Pioneering work on nanospheres: Fujita, etal. a) *Angew. Chem. Int. Ed.* **2004,** *43,* 5621 b) *Science* **2010**, *328*, 1144 c) *Chem. Commun.* **2009**, *13*, 1638. d) J.P Stang et al. J. *Am. Chem. Soc.* **1999**, *121*, 10434.
3. For some of our work on nanospheres a) Reek et al., "*Nature Chemistry*, **2016** *8*, 225-230; b) Reek et al *Angew. Chem., Int. Ed.,* **2014,** *52,* 13380; c) Reek et al *Angew. Chem., Int. Ed.,* **2018,** *57,* 11247; d) Reek et al *Chem. Sci.,* **2019**,*10*, 1316. e) Reek et al *J. Am. Chem. Soc.* **2020,** *142* (19), 8837.f) Reek et al *J. Am. Chem. Soc.* **2022**, *144,* 15633
4. Reek et al *Chem* **2023**, in press https://doi.org/10.1016/j.chempr.2023.03.018