CiQUS

Centro Singular de Investigación en Química Biolóxica e Materiais Moleculares

Conferencia: Complex Functions from Self-assembling Systems with Simple Precursors

Jonathan Nitschke

University of Cambridge

24/04/14

....

Aula de Seminarios do CIQUS

12:15 h

Más información:
www.usc.es/ciqus

XUNTA DE GALICIA
CONSELLERÍA DE CULTURA, EDUCACIÓN E ORDENACIÓN UNIVERSITARIA

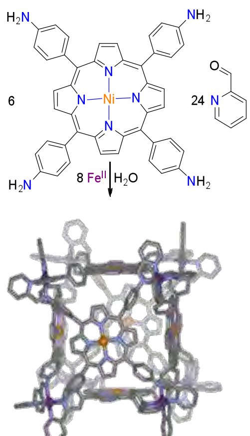
USC UNIVERSIDADE DE SANTIAGO DE COMPOSTELA

CAMPUS VIDA
CAMPUS DE EXCELENCIA INTERNACIONAL

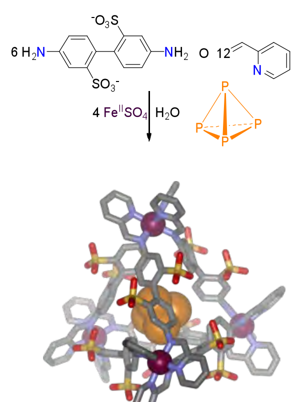
Complex Functions from Self-assembling Systems with Simple Precursors

Jonathan R. Nitschke
Department of Chemistry, University of Cambridge   jrn34@cam.ac.uk   http://www-jrn.ch.cam.ac.uk/

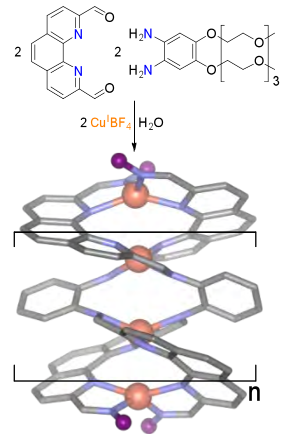
The materials that we depend on rely upon ever-increasing structural complexity for their function. Designing complex materials for these devices through the art of chemical synthesis brings challenges and opportunities. The use of chemical self-assembly as a synthetic technique can simplify materials preparation by shifting intellectual effort away from designing molecules, and towards the design of *chemical systems* that are capable of self-assembling in such a way as to express the desired materials properties. This talk will focus upon the design of self-assembly processes that can bring together simple, organic molecules and first-row transition-metal ions into complex, functional structures. Below are shown the subcomponent precursors and crystal structures of three of these products: Fe^{II}_8 cubic cage **1**,[1] Fe^{II}_4 tetrahedral cage **2**,[2] and white-light electroluminescent Cu^{I}_n double-helical polymer **3**.[3]



1



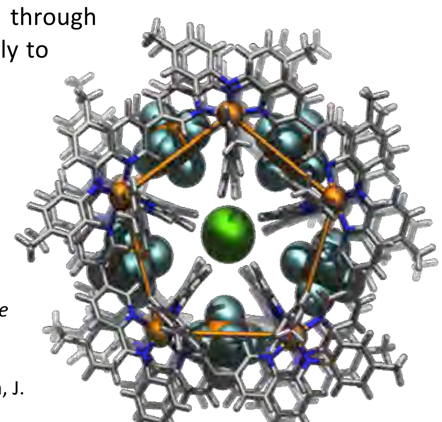
2



3

Each of these products was prepared simply by mixing the precursors shown in water. Although the starting materials employed are simple, a complex understanding is required of the selectivities of the reversible bond-forming reactions and second-order interactions between subcomponents. Structural complexity may enable novel function; for example, cube **1** will selectively bind to higher fullerenes, enabling their extraction from fullerene soot,[1] cage **2** is capable of rendering air-stable white phosphorus (P_4), which is ordinarily pyrophoric,[2] and photoluminescent polymers that gel organic solvents as the temperature is raised[4] have been prepared using the ideas that underpin **3**.

If the rules underlying a self-assembly process are well understood, these rules may allow the parallel preparation of multiple structures at once, or the transformation of structures in complex ways.[5] Our techniques thus allow entry into the emerging field of *systems chemistry.*[6] One recent example is a $M_{10}L_{15}$ pentagonal prism **4**, shown at right, which forms part of a chemical network that behaves differently under the influences of different chemical signals.[7] This prism is formed through the action of hexafluorophosphate template ions, and it binds tightly to chloride once formed.



4

[1] W. Meng, B. Breiner, K. Rissanen, J. D. Thoburn, J. K. Clegg, J. R. Nitschke, *Angew. Chem. Int. Ed.* **2011**, *50*, 3479.

[2] P. Mal, B. Breiner, K. Rissanen, J. R. Nitschke, *Science* **2009**, *324*, 1697.

[3] X. de Hatten, D. Asil, R. H. Friend, J. R. Nitschke, *J. Am. Chem. Soc.* **2012**, *134*, 19170.

[4] X. de Hatten, N. Bell, N. Yufa, G. Christmann, J. R. Nitschke, *J. Am. Chem. Soc.* **2011**, *133*, 3158.

[5] V. E. Campbell, X. d. Hatten, N. Delsuc, B. Kauffmann, I. Huc, J. R. Nitschke, *Nature Chem.* **2010**, *2*, 684.

[6] J. R. Nitschke, *Nature* **2009**, *462*, 736.

[7] I. A. Riddell, M. M. J. Smulders, J. K. Clegg, Y. R. Hristova, B. Breiner, J. D. Thoburn, J. R. Nitschke, *Nature Chem.* **2012**, *4*, 751.