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Molecular architecture and engineering:

Organometallocavitands as functional pores and building blocks

The development of innovative functional materials, that can help to tackle a variety of challenges, including environmental and medicinal problems, is a central aim of synthetically oriented chemists. The range of desired applications hereby is large: There is a need of materials that can efficiently reduce energy consumption (catalysts), store or refine fuels (gas storage & separation material), or in the medicinal context can be employed for diagnostics (contrast agents) or therapeutics (drugs, drug delivery).

Porous materials have been applied for some of these purposes quite some time, especially for separation and storage applications. One approach to design new materials towards desired properties is to build up multi-dimensional frameworks out of organic building blocks. These are connected either covalently (COFs) or via metal nodes (MOFs). Additionally, also discreet molecules with cavities – so-called cavitands – can be used as single pores for a variety of applications. However, in contrast to their rather projectable topology, the (post-synthetical) inclusion of further functionality into these materials is often difficult.

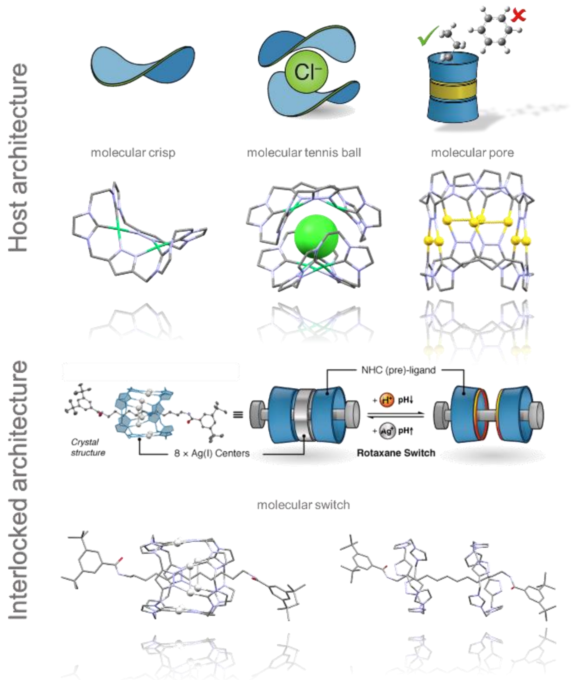

Figure 1. Differently shaped organometallocavitands and use in a pH-dependent molecular switch.

To overcome these limitations we employ organometallic complexes, e.g. the tubular 'pillarplexes', which exhibit defined cavities and additionally possess intrinsic functionality, e.g. photoluminescence, selective guest recognition, easily adjustable polarity/solubility.[1-3] Furthermore, the complexes can be employed as building blocks in mechanically-interlocked molecules, namely rotaxanes, forming a pH-responsive molecular switch.[4] Depending on the metal employed, they also show different toxicity which renders them interesting candidates for applications in the biological context.[5] In the talk, the synthesis, structural characterisation and functional properties of these novel organometallic architectures are presented and current as well as envisioned future applications are discussed.

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