Formation and Binding Properties of Cyclohexanohemicucurbiturils

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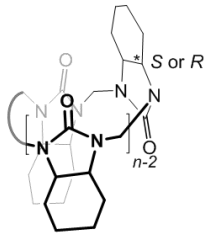
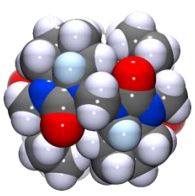
Hemicucurbiturils (HC) are host molecules that can bind a variety of small-sized anions within their cavity. HCs can be modified by adding side-chains, such as a cyclohexano group. Several cyclohexanohemicucurbiturils (cycHC) are chiral [1,2], which makes them stand out among the wide assortment of hosts known in supramolecular chemistry.

A new variety of cycHC's, composed of (*R,S*) or *cis*-cyclohexa-1,2-diylurea monomers, has recently been synthesized and characterized in our group.[3] Their cavities are not closed like those of their chiral diastereomers ((*S,S*)-and (*R,R*)-cycHC[6], but tube-like, affecting their binding.[3]

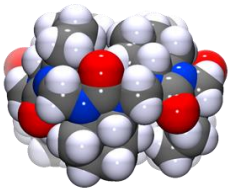
The macrocycles are formed in a single step in a mixture of substituted ethyleneurea, formaldehyde, and a template ion under acidic conditions. The template determines the size of the product and leads to accumulation of thermodynamically more stable cycHC.[2,3]



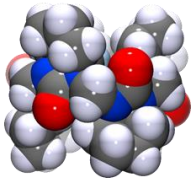
cycHC[*n*]



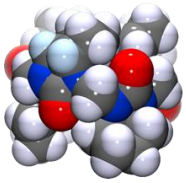
(*S,S*)-cycHC[6]



(*R,R*)-cycHC[8]



cis-cycHC[6]



inverted-cis-cycHC[6]

The mechanism of formation of the cycHC macrocycles has been modelled computationally and an explanation for the observed behavior has been found.[2,3]

Several series of host-guest binding studies have also been performed, yielding complexation equilibrium constants with a variety of anionic[4,5] and electron-rich neutral guests. Electron-deficient guests have been found to bind at the outside of the macrocycles, instead of entering into the cavity.[3,6] Cavity shape and size make the macrocycles selective towards guests, and due to chirality of the macrocycle, enantiomers of the guests can be distinguished. This property is now being put into practical use in development of chiral sensors.

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