Molecular capsule: helical ribbon with closed ends takes up guest molecules

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Tiny molecular "containers" that can take up other molecules as "guests" are of particular interest for technology and science, as catalysts, micro-reaction-chambers, transport containers for pharmaceutical agents, or protective covers for unstable molecules. Various strategies have now been established for building such miniature capsules. Ivan Huc and Joachim Garric (European Institute of Chemistry and Biology, Pessac), as well as Jean-Michel Léger (Laboratoire de Pharmacochimie, Bordeaux) have now developed a novel approach.

The French chemists synthesized a strand-like molecule from aromatic amine building blocks -- nitrogen-containing carbon rings. The building blocks are chosen so that the ribbon curls into a helix. The crucial trick is that the helix is not even: it has a significantly larger diameter in the middle than at the ends. The researchers can precisely control the inner diameter by the selection of individual building blocks and the precise arrangement of the nitrogen atoms within the ring system. They thus select correspondingly different building blocks for the middle and end sections of the spiral ribbon. This results in a helix with a real bubble in the middle and ends without a cavity, which close off the bubble. The capsule is thus complete.

"Our capsules are constructed so that they take up a single water molecule," says Huc. "They enclose it completely and shield it from surrounding organic solvents." And how does the water molecule get into the capsule? Nuclear magnetic resonance studies support the theory that the helices partially unravel at one end, let the water molecule slip in,

and then close again."

The researchers now want to expand their highly promising concept. They are thus working on larger capsules that could take up larger or multiple molecules.