

A molecular motor design breakthrough

March 4 2011

French researchers from CNRS and the Universite de Bordeaux, in collaboration with a Chinese team , have developed the first molecular piston capable of self-assembly. Their research represents a significant technological advance in the design of molecular motors. Such pistons could, for example, be used to manufacture artificial muscles or create polymers with controllable stiffness. The results are published on 4 March 2011 in the journal *Science*.

Living organisms make extensive use of molecular motors in fulfilling some of their vital functions, such as storing energy, enabling cell transport or even moving about in the case of [bacteria](#). Since the molecular layouts of such motors are extremely complex, scientists seek to create their own, simpler versions. The motor developed by the international team headed by Ivan Huc , CNRS researcher in the “Chimie et Biologie des Membranes et des Nanoobjets” Unit, is a “molecular piston”. Like a real piston, it comprises a rod on which a moving part slides, except that the rod and the moving part are only several nanometers long.

More specifically, the rod is formed of a slender molecule, whereas the moving part is a helix-shaped molecule (both are derivatives of organic compounds especially synthesized for the purpose). How can the helicoidal molecule move along the rod? The acidity of the medium in which the [molecular motor](#) is immersed controls the progress of the helix along the rod: by increasing the acidity, the helix is drawn towards one end of the rod, as it then has an affinity for that portion of the slender molecule. By reducing the acidity, the process is reversed and the

helix goes in the other direction.

This device has a crucial advantage compared to existing molecular pistons: self-assembly. In previous versions, which take the form of a ring sliding along a rod, the moving part is mechanically passed onto the rod with extreme difficulty. Conversely, the new piston is self-constructing: the researchers designed the helicoidal molecule specifically so that it winds itself spontaneously around the rod, while retaining enough flexibility for its lateral movements.

By allowing the large scale manufacturing of such molecular pistons, this self-assembly capacity augurs well for the rapid development of applications in various disciplines: biophysics, electronics, chemistry, etc. By grafting several pistons together end-to-end, it could be possible, for example, to produce a simplified version of an artificial muscle, capable of contracting on demand. A surface bristling with molecular pistons could, as and when required, become an electrical conductor or insulator. Finally, a large-scale version of the rod on which several helices could slide would provide a [polymer](#) of adjustable mechanical stiffness. This goes to show that the possibilities for this new molecular piston are (almost) infinite.

More information: Helix-Rod Host-Guest, Complexes with Shuttling Rates Much Faster than Disassembly. Quan Gan, et al. *Science*. 4 March 2011.

Provided by CNRS

Citation: A molecular motor design breakthrough (2011, March 4) retrieved 27 April 2024 from <https://phys.org/news/2011-03-molecular-motor-breakthrough.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.