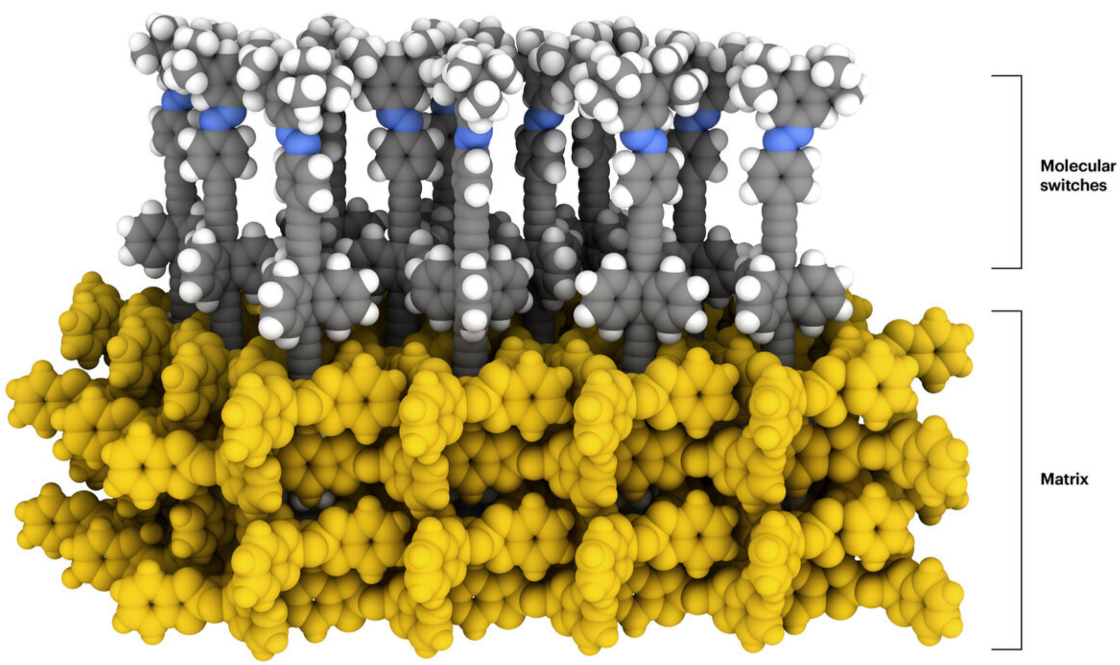
NMR confirms molecular switches retain function in 2-D-array

May 13 2020

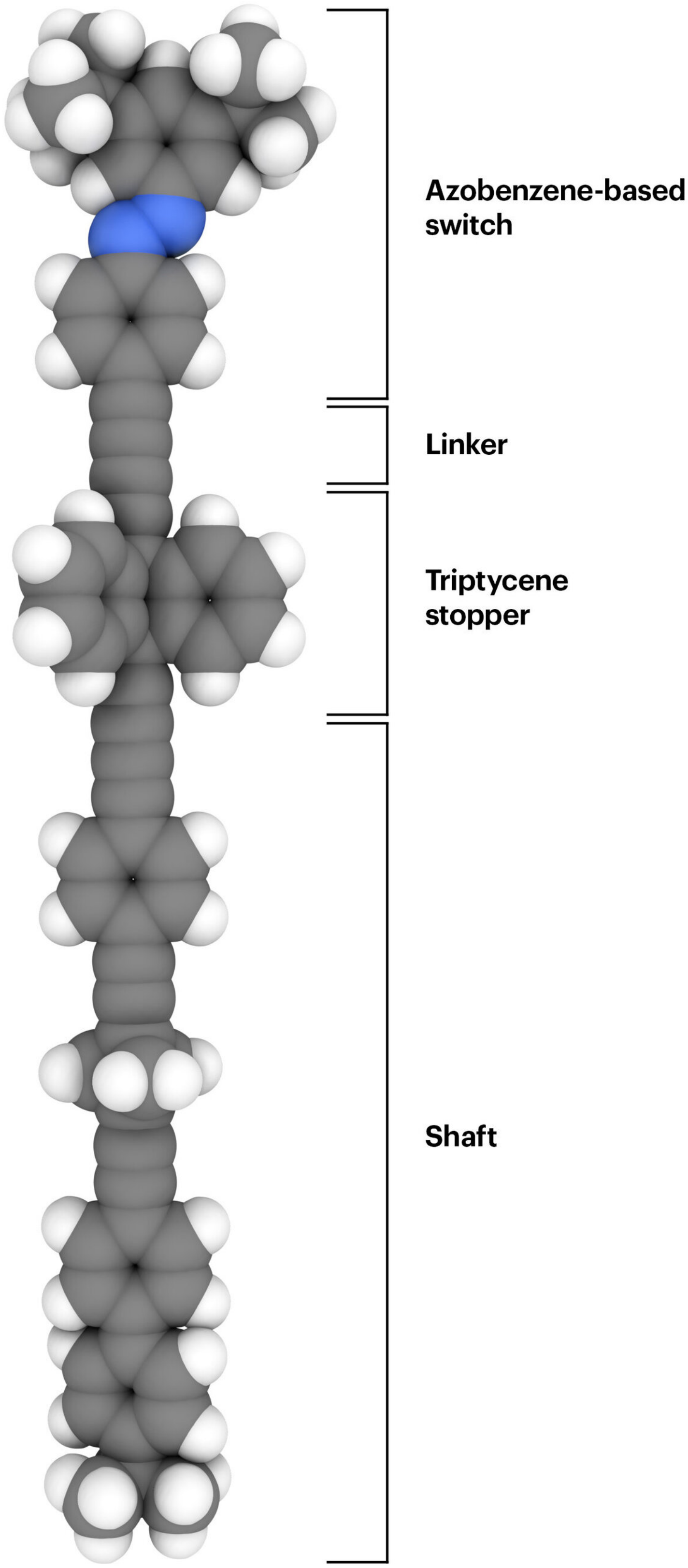


Regular 2D assembly of isotopically labelled molecular switches (Source: uochb.cz/en/news/171) Credit: Tomas Bellon / IOCB Prague

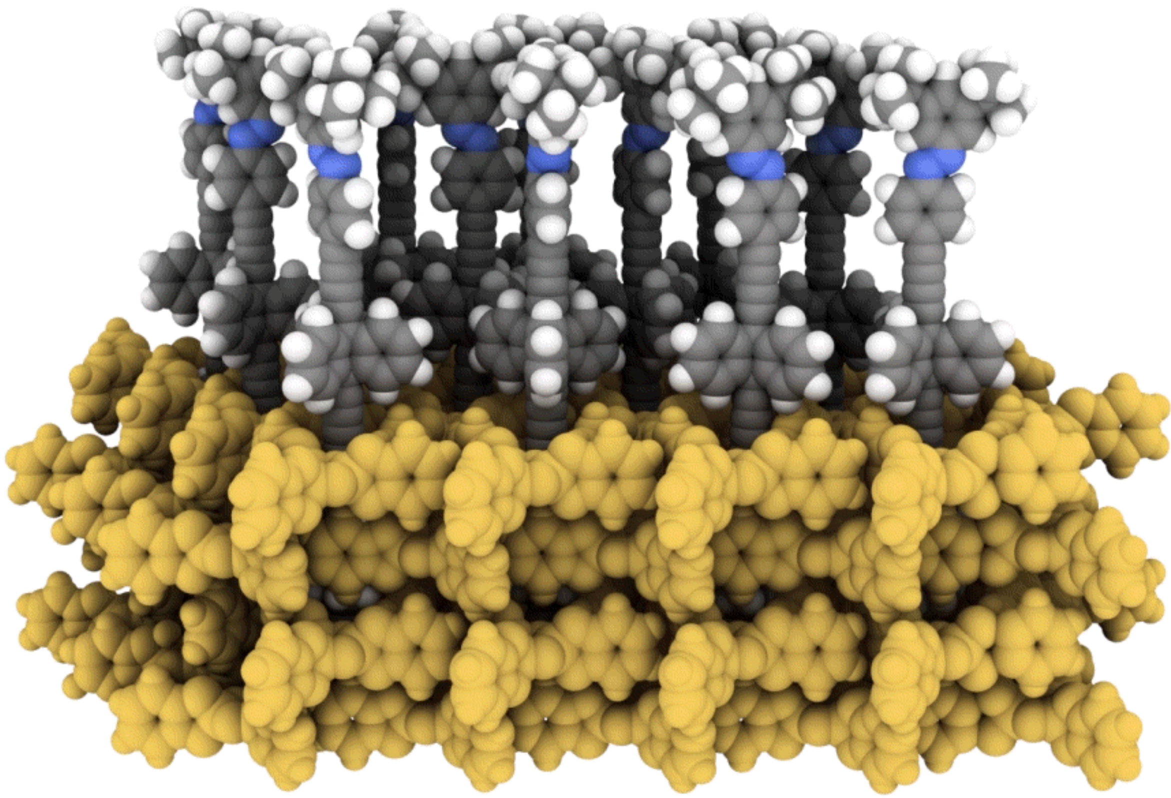
Researchers led by Jiří Kaleta of IOCB Prague have synthesized regular 2-D assemblies of isotopically labelled molecular switches and measured the properties of their isomerization, revealing that formation of such an assembly doesn't hamper the photochemical switching properties of the embedded molecules. The isotopic labels came into use when measuring switching properties using an analytic technique dependent on the labels. The team published the results in the *Journal of the American Chemical Society*.

Self-organization of individual molecular machines, such as motors, rotors, and switches, into regular and well-defined two- (2-D) or three-dimensional (3-D) arrays is a promising path towards a new generation of smart materials. Two-dimensional assemblies seem to be particularly interesting because of their possible application in fields such as optics (OLEDs) and nanoelectronics (memory devices, frequency filters, etc.).

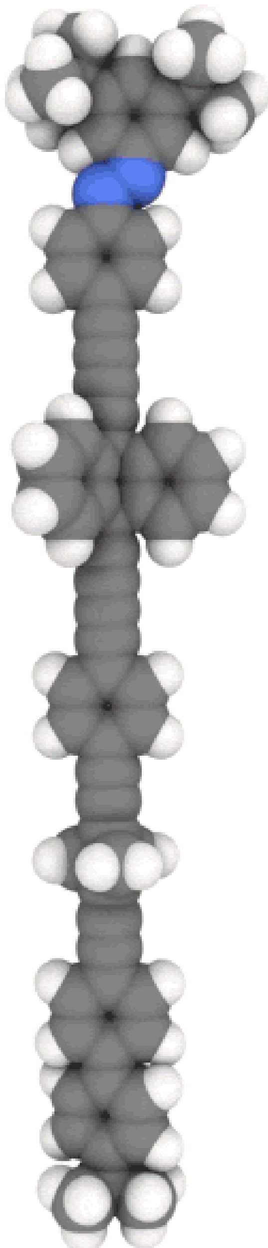
In collaboration with researchers from the Faculty of Science, Charles University in Prague and the University of Colorado, the IOCB Prague team obtained these assemblies with a method previously tested on other molecular machines in accordance with their ongoing research in the 2-D arrays of such supramolecular systems. The researchers mounted the molecular switch moieties (substituted azobenzenes) onto rod-like molecules and distributed them on the porous nanocrystals of a tris(*o*-phenylenedioxy)cyctlotriphosphazene (TPP) matrix. The regularly distributed straight pores enforced the regular spread and parallel orientation of these structures.


Azobenzene-based switch
Linker
Triptycene stopper
Shaft

Isotopically labelled molecular switch (Source: uochb.cz/en/news/171) Credit: Tomas Bellon / IOCB Prague



Regular 2D assembly of isotopically labelled molecular switches. (Source: uochb.cz/en/news/171) Credit: Tomas Bellon / IOCB Prague



Isotopically labelled molecular switch (Source: uochb.cz/en/news/171) Credit: Tomas Bellon / IOCB Prague

The researchers labelled the switches ^{15}N, which allowed them to use solid-state ^{15}N NMR spectroscopy to detect the *cis*/*trans* isomerization. A suite of other analytical techniques confirmed the regular structure of the assemblies. Comparison of thermal steps in solution and supramolecular surface inclusions revealed that switching of individual molecules is not compromised by the close proximity of neighbors.

Binding the molecular switches to the surface of a solid material produces several key advantages. Unlike in bulk crystals, the switch segments of the molecules have enough space to change their configuration. And unlike in a solution, the molecules are part of a solid periodical system, giving more control of their position, which may lead to the potential use of such materials in applications where their specific position plays a role, e.g. memory devices.

More information: Santos Hurtado et al. Regular Two-Dimensional Arrays of Surface-Mounted Molecular Switches: Switching Monitored by UV–vis and NMR Spectroscopy. *Journal of the American Chemical Society* 2020. DOI: 10.1021/jacs.0c01753

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