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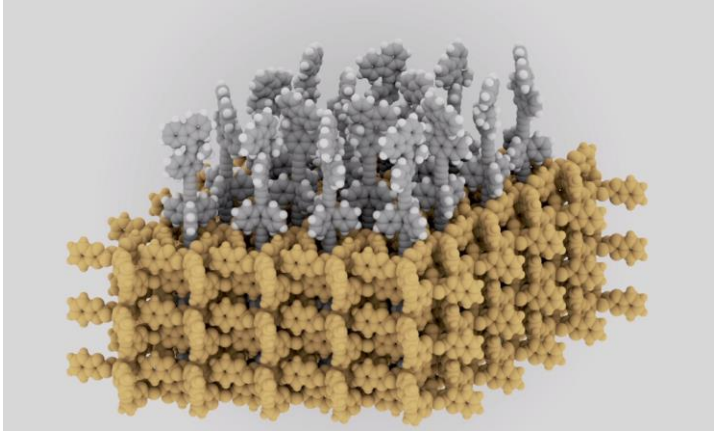
PRESS RELEASE

Scientists created an organized array of light-driven molecular motors

Prague, August 10, 2017* – Researchers from the Institute of Organic Chemistry and Biochemistry of the Czech Academy of Sciences (IOCB Prague) built a 2-dimensional organized array of light-driven molecular motors. At the molecular level, they have created a system of regularly spaced microscopic machines rotating when illuminated. The team headed by Dr. Jiří Kaleta (Prof. Josef Michl Group) collaborated with the 2016 Nobel laureate in chemistry Prof. Ben Feringa. Their research was published in the prestigious *Journal of the American Chemical Society (JACS).

The IOCB Prague researchers wondered whether molecular motors can be precisely positioned to form a 2-dimensional regular array and whether the motors will still be functional when arrayed. What seems a trivial matter at the macroscopic level may, however, at the nanoscale prove to be challenging. Even though scientists have succeeded in creating and manipulating individual molecules, a system of thousands of molecular motors would take many years to generate using current methodologies.



Jiří Kaleta and his team, therefore, looked for ways to make the molecules self-arrange. *„We decided to use tris(o-phenylene)cyclotriphosphazene (TPP), which is widely used for these purposes in Josef Michl Group. Its crystals create small plates containing long, straight channels that reach the surface and run perpendicular to that surface,“* explains Dr. Jiří Kaleta *„This compound forms very easily complexes with other molecules that are happy to go inside the voids and don't come back out.“*

Then the researchers designed and synthesized (in dozens of steps) the molecular motor. The final molecule is in a shape of a rod carrying the motor at its top. The other side of the rod is then slightly smaller than the diameter of the channel in the TPP crystal and serves as an anchor of the compound. The molecule is able to get inside the channel in the TPP matrix and can be seated there permanently. The motor molecule is also equipped with a stopper preventing the motor from drowning in the void and thus losing its ability to rotate.

The rotation itself is driven by light. *„The motor is fueled by a light of a particular wavelength. Illumination makes the motor turn partially, and then the rotor turns the rest of the way on its own. Another illumination initiates the next cycle and it can go on like this for ever. Each illumination brings about a rotation just like when fuel is injected into a car engine cylinder,”* says Jiří Kaleta.

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Once the researchers synthesized the motors and arranged approximately two thousands of them regularly onto the surface of a substrate, they were able to demonstrate that the light-driven rotation is not compromised by either the surface confinement or the density of surface coverage.

Development of molecular motors is still in its early days and in the basic research realm, but it is clear that it has a great potential and is drawing a great deal of attention, as illustrated by the 2016 Nobel prize in chemistry awarded for the research in this field. The discovery by the IOCB Prague team and their colleagues shows how to move away from manipulating with individual motors to organized arrays of millions or billions of units with dramatically increased impact. This will enable us to study motors more conveniently and in an appropriately designed system could eventually lead to the transport of microscopic objects along the surface with the use of just light as a trigger and fuel of the process.

Original paper: Kaleta, J.; Chen, J.; Bastien, G.; Dračínský, M.; Mašát, M.; Rogers, C. T.; Feringa, B. L.; Michl, J. “Surface Inclusion of Unidirectional Molecular Motors in Hexagonal Tris(*o*-phenylene)cyclotriphosphazene TPP” *J. Am. Chem. Soc.* **2017**, *139*, 10486-10498. (DOI: 10.1021/jacs.7b05404)

The Institute of Organic Chemistry and Biochemistry of the Czech Academy of Sciences / IOCB Prague (www.iocb.cz) is a leading scientific institution in the Czech Republic, recognized internationally. Its primary mission is basic research in the fields of chemical biology and medicinal chemistry, organic and material oriented chemistry, chemistry of natural compounds, biochemistry and molecular biology, physical chemistry, theoretical chemistry, and analytical chemistry. The Institute has a long tradition and expertise in medicinal chemistry and drug development together with the pharma industry. Antivirals discovered by Antonín Holý and developed further by Gilead Sciences revolutionized the treatment of AIDS and hepatitis B and have significantly improved lives of millions of people around the globe.

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SUPPLEMENTARY MATERIAL:

Video: www.youtube.com/watch?v=vCFfiA4xJV0

GIF animations: http://gph.is/2uo83dX, http://gph.is/2vMTNz0

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