C&EN’s writers and editors look at the science that shone brightest in 2017: The biggest headlines. The most thrilling research findings. The coolest new molecules. And much more.

In brief
- Research of the year P.20
- Headlines of the year P.30
- What to watch for in 2018 P.40
- Look back at 2007 P.42

More online
- Find more of C&EN’s Year in Chemistry at cenm.ag/yic2017.
BIG MOVES FOR LITTLE DEVICES

Geared up after last year’s Nobel nod, researchers put rotors, drills, pulleys, and more into action

Since the 1980s, chemists have been creating molecular machines—single molecules that resemble and function like motors, rotors, and even tiny cars. When three molecular machine pioneers won the 2016 Nobel Prize in Chemistry, the field gained a certain gravitas: The whirligig molecules being created were certified as more than mere chemical curiosities. It’s not a surprise that molecular machines continued to make headlines this year, including a souped-up motor-rotor combo, polymer pulleys designed to boost battery performance, and the world’s first nanocar race.

“It is fascinating to see the current acceleration in the field,” says Ben L. Feringa, one of the 2016 Nobel laureates. “The recent ingenious designs, ranging from molecular pumps to reshaping polymers, reflect how molecular machines will bring responsive and adaptive behavior, enabling numerous potential applications.” Here C&EN revisits some favorite molecular machine stories of 2017.—BETHANY HALFORD

Drilling holes in cells

Scientists led by Rice University’s James M. Tour turned ultraviolet light-activated molecular motors into tiny drills that can bore through cellular membranes. The idea is to get enough motors drilling into cancer cells in order to destroy the cells’ integrity in a matter of minutes. Cancer cells can’t develop a resistance to the molecular motor’s motion the way they do for many chemotherapy treatments, Tour says (Nature 2017, DOI: 10.1038/nature23657).

Chiral construction by molecular machines

David A. Leigh and coworkers at the University of Manchester built a programmable molecular machine that creates four different products by adding thiol and alkene substituents asymmetrically to an α,β-unsaturated aldehyde substrate. The machine features an arm and rotatory switch that moves between a site for R stereochemistry and a site for S stereochemistry depending on pH (Nature 2017, DOI: 10.1038/nature23677).
**Motor-rotor combo on the move**

The University of Groningen’s Ben L. Feringa upped the complexity of the classic light-activated molecular motor his group is known for by attaching a rotor to it. The two components turn with synchronized movement thanks to the assembly’s complex stereochemical design (Science 2017, DOI: 10.1126/science.aam8808).

**Polymer ‘pulleys’ for boosting battery performance**

Researchers led by Ali Coskun and Jang Wook Choi at Korea Advanced Institute of Science & Technology developed polymers that, when added to a silicon anode, can relieve the stress the anode undergoes when charging and discharging so that it will last longer. The secret to the polymer’s success: a network made of the linear polymer polyacrylic acid covalently linked to polyrotaxanes containing mechanical bonds. During battery charging, as the silicon anode expands, the polyrotaxanes’ rings freely slide along the chain to dissipate stress, operating like a pulley system (Science 2017, DOI: 10.1126/science.aal4373).

**Winding and unwinding**

By combining two types of light-activated molecular machines, a team led by the University of Strasbourg’s Nicolas Giuseppone created a twisting system that winds and unwinds polymer chains, resulting in a material that contracts and expands depending on the wavelength of light shining on it. The system could lead to new types of actuators—for example, in artificial muscles (Nat. Nanotechnol. 2017, DOI: 10.1038/nnano.2017.28).