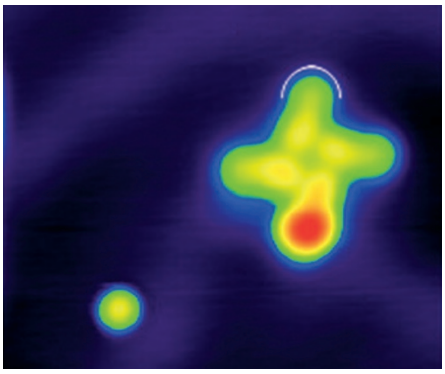
MOLECULAR MACHINES

Hauling atomic-size loads

ACS Nano http://doi.org/6m3 (2015)



AMERICAN CHEMICAL SOCIETY

Conversion of thermal or electrical stimuli into mechanical motion can be controlled at the molecular scale; this has been previously demonstrated, among others, by Gianaurelio Cuniberti and colleagues, who synthesized windmill-shaped supramolecular nanostructures that move on a gold surface when stimulated by a voltage pulse applied through the tip of a scanning tunnelling microscope. Now, this group shows that such nanostructures can also act as molecular electromechanical systems; guided by controlled electrical pulses, they can pick up and transport single gold atoms, gold dimers and small molecules adsorbed on the surface. The researchers verified that the motion is neither due to a mechanical interaction of the tip with the nanostructures nor to direct electrical driving of the transported particles. Depending on the sign of the applied voltage, the loads can be rotated by a small angle or translated by a few ångströms, demonstrating a fine control that may be useful for the realization of more complex molecular machines. *LM*

CO_2 CAPTURE

Bespoke zeolites

Nature **524,** 74–48 (2015)

The capability of porous materials such as metal–organic frameworks and zeolites for high capacity and selective molecular adsorption makes them very attractive materials for the separation and storage of gases such as CO_2. Although the porosity of metal–organic frameworks can be easily tailored to control their adsorptive characteristics, this is more difficult for inorganic zeolites. The characterization of new zeolites to confirm their structures is also less straightforward. A team led by Suk Bong Hong, Paul Wright and Xiaodong Zou now present a strategy by which zeolite structures can be predictably designed. By using electron diffraction to solve the structure of the zeolite ZSM-25, they identified a number of structural features similar to those of the smaller zeolite, paulingite. Using these as a 'structural coding' they then succeeded in designing and synthesizing sequentially expanded structures with increased complexity and unit-cell volume compared with ZSM-25 but bearing the same structural features, and importantly, the same capability for selective CO_2 adsorption. *JH*

MICROSCOPY

Around the single atom

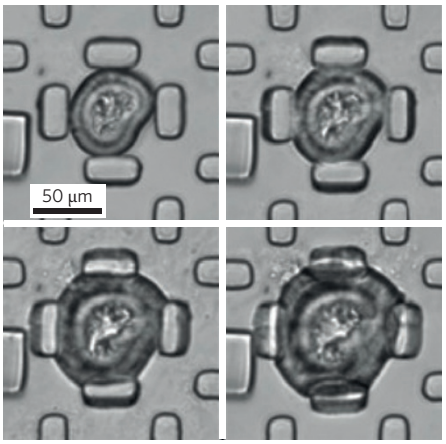
Phys. Rev. Lett. **115,** 026101 (2015)

Kelvin probe force microscopy (a version of atomic force microscopy) is currently the most promising in terms of the mapping of the electrostatic potential at the single-atom and single-molecule levels. However, it is very sensitive to the distance between the conducting tip and the surface under investigation, which can make it less reliable. Stefan Tautz and colleagues now present an alternative approach, where a quantum dot is attached to the end of the tip. Quantum dots are sometimes referred to as artificial atoms, as they exhibit distinct energy levels, which shift in the presence of electrostatic gating. The team follows these changes when the tip is close to the target atom or molecule, allowing them to map the field around their target in three dimensions with high sensitivity. The ability to detect the electrostatic potential while away from the surface (the authors report a 6 nm distance), can be useful for the characterization of rougher samples. *MM*

AMYLOID FIBRILS

Forceful growth

Proc. Natl Acad. Sci. USA **112,** 9524–9529 (2015)



NAS

Because of its association with various neurodegenerative disorders, much is known about the formation mechanism and accumulation, in organs, of insoluble fibrous aggregates of misfolded proteins. Yet less attention has been paid to the dynamic properties of these amyloid fibrils. By imaging the deflection of arrays of deformable microcantilevers surrounding radially growing amyloid structures in a microfluidic device, Therese Herling *et al.* have now measured the forces generated by amyloid growth. The researchers found that the force levels associated with the growth of a single amyloid filament are comparable to those of polymers that have naturally evolved to generate force, such as actin filaments and microtubules, and that the power density released by amyloid growth is comparable to that of high-performance polymeric microactuators. Amyloid structures can thus be considered as force-generating materials (their formation is energetically favourable), and could make for powerful microactuators in solution (notwithstanding the persistence of the fibrils under physiological conditions). *PP*

GRAPHENE

High-quality delamination

Science Adv. **1,** e1500222 (2015)

Mechanical exfoliation from graphite is known to yield high-quality graphene with impressive electrical performance. Synthesis of graphene on a large scale is needed for its commercialization though, and chemical vapour deposition (CVD) is deemed a suitable route for meeting production demands. However, separation of graphene from the archetypal copper substrate requires contact with a transfer polymer, and the etching of the copper substrate, both of which retard crystal — and electrical — quality. Delamination of CVD graphene is a more attractive approach, with the added advantage that the metal substrate can be re-used for subsequent growth cycles, but has to date resulted in samples with poorer electrical properties than exfoliated ones. Now, Luca Banszerus *et al.* report a delamination approach utilizing the strong van der Waals interactions between graphene and hexagonal boron nitride (hBN) to lift graphene from the copper substrate, removing the need for crystal-degrading chemical steps. The resultant hBN/graphene heterostructure displays mobilities up to 350,000 $cm^2 V^{-1} s^{-1}$, comparable to exfoliated graphene. *JP*

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