BIOPHYSICS

Attachment issues

Biophys. J. **110,** 218–233 (2016)

When bird flu became transmissible between mammals, the mutation was surprisingly slight: a 1.4-fold increase in molecular binding affinity at the interface between the virus and its host. Now it seems thermodynamics might be able to tell us why. Huafeng Xu and David E. Shaw have devised a model for biological adhesion, which suggests that small changes in these affinities can give rise to larger increases in adhesion affinity — enough, perhaps, to switch the virus' binding preference from avian to mammalian cells.

Similar models have been used to describe interactions on a molecular level, where there are only a handful of binding pairs. But when a virus invades a host cell, the contact area often covers hundreds — if not thousands — of binding sites. Xu and Shaw took advantage of this to invoke approximations appropriate for many interactions. They estimated affinities consistent with those measured in experiments, and uncovered a mechanism by which weak binding may be amplified to facilitate high-affinity adhesion.

The study could help us stem the spread of influenza via competitive inhibition, which reduces the number of available connection sites. The authors' model suggests that even a relatively weak inhibitor could compromise adhesion in this way. *AK*

HELIUM MICROSCOPY

Compare and contrast

Nature Commun. **7,** 10189 (2016)

Microscopists are fond of the saying 'seeing is believing'. And given the pervasive use of their technique across the natural sciences, few could blame them. However, many systems remain challenging to image, such as transparent, weakly bonded or extremely rough materials. Perhaps most notably, delicate structures such as biological samples can degrade under the energetic probes of traditional microscopy based on electrons or X-rays.

Scanning helium microscopy (SHeM) offers one way around this problem by providing a probe that is chemically, electrically and magnetically inert, and therefore non-destructive. For the most part, SHeM studies have focused on elastic scattering of the helium atoms, such that structural defects such as adsorbates or terraces on the surface of the sample usually dominate the imaging contrast. Chemical information has proven much harder to obtain.

By focusing on inelastic scattering processes — which have signals typically two or three orders of magnitude smaller than their elastic counterparts — Matthew Barr and colleagues have shown they contain important information about the chemical composition of a sample surface. The authors tested their technique on different metallic species, but in principle it is also applicable to more complex electronic and biological systems. *AT*

STATISTICAL PHYSICS

Lattice wetting

Phys. Rev. Lett. (in the press); preprint at http://arxiv.org/abs/1410.8574

At first sight, the standard Ising model seems rather detached from wetting — the process by which a liquid makes contact with a surface. If, however, you think of the Ising spins on a 2D lattice as defining a surface with wet (spin up) and non-wet (spin down) patches, you have a vehicle for understanding wetting phenomena.

The trick is to introduce a field that acts on the spins of the surface. Xintian Wu and colleagues performed an Ising treatment of wetting in a 2D context: a square spin lattice where the 'surface' is actually a row of spins. The authors included an extra energy term to distinguish surface from bulk spin–spin interactions. The exact solution of this system shows that the wetting transition (from a partially to a completely wet surface) is of second order, but turns first order in the limit of an infinite surface-to-bulk spin–spin interaction ratio.

When the ratio is much larger than one, the transition appears first order as the critical region decreases exponentially and is therefore practically invisible to numerical studies — calling for caution when simulating critical phenomena. *BV*

METASURFACES

Double up

Sci. Adv. **2,** e1501168 (2016)

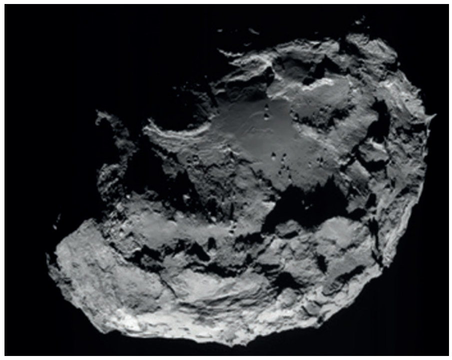
Metasurfaces are flat, ultrathin systems that can shape and manipulate light on length scales far smaller than those accessible with conventional optical components. Although potentially useful for optical device miniaturization, plasmonic metasurfaces often don't perform well when it comes to visible light. Fei Qin and colleagues have now shown that bilayer structures provide a route for manipulating visible light more efficiently.

Comprising arrays of metallic nanostructures, plasmonic metasurfaces shape light through its interaction with the plasmonic modes. Qin *et al.* looked at combining the response of an array of metallic elements with its inverse: a metallic film with an array of holes. By integrating a capacitive metasurface with an inductive one, they could manipulate the phase of cross-polarized transmitted light more efficiently than is possible with a single-layer plasmonic metasurface. So despite having much higher losses, metallic metasurfaces can be used to manipulate light with efficiencies similar to their dielectric counterparts. *LF*

ROSETTA MISSION

Space oddity

Nature http://doi.org/bbvn (2016)



NPG

Finding water on a comet might not come as a big surprise, after all it is one of the main components of the cometary nucleus and comas are made mostly of water vapour. But finding exposed water ice is news, because many comets observed so far — including 67P/Churyumov–Gerasimenko (67P; pictured), made famous by the Rosetta mission — are dark and dusty; true 'icy dirtballs'. Now, using the Rosetta mission cameras and Visible Infrared and Thermal Imaging Spectrometer (VIRTIS), Gianrico Filacchione and colleagues have identified two regions of exposed water ice.

Filacchione *et al.* spotted two bright patches in the Imhotep region of 67P. Taking a closer look at these features, they found that they were debris falls where ice has been exposed. The VIRTIS spectra confirm this is indeed pure water ice made of millimetre-sized grains — much larger than one would expect from vapour condensation. The large ice grains are likely the result of more complex processes such as growth by vapour diffusion or sintering, suggesting that the coating of the nucleus keeps evolving by the build-up of overlapping dirt and ice layers. *IG*

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