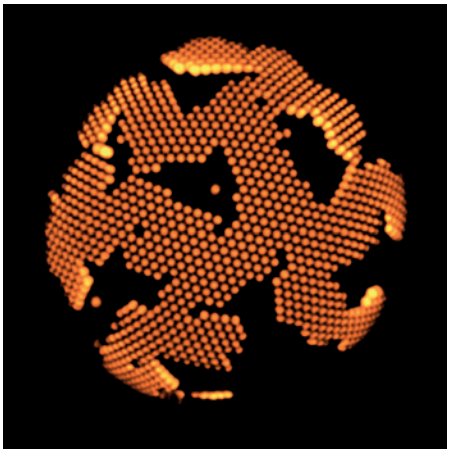
CRYSTALS

Growth on a curve

Science **343,** 634–637 (2014)



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Crystallization is a ubiquitous phenomenon that has been studied for centuries. However, the effect of substrate curvature on the process is not well understood, despite the fact that it could provide insight into the growth of curved nanostructures such as functionalized nanoparticles and viral capsids. To address this issue, Vinothan Manoharan and colleagues at Harvard University have now explored the growth of two-dimensional colloidal crystals on the inside walls of spherical water droplets.

Using confocal microscopy, the researchers examined the assembly of polystyrene microspheres in water-in-oil droplets that had various different curvatures. The polystyrene spheres were mixed with smaller polymer nanoparticles, which induce short-range depletion attractions between the spheres. This depletion attraction is an entropic force that results from an exclusion of the nanoparticles from the intersphere region. The force also confines the spheres to the interface of the droplets.

Over the course of a few hours, the spheres were found to form branched, ribbon-like domains, which left large empty spaces on the droplets. If the crystals had been grown on a flat surface these voids would have been filled with other spheres. However, on curved surfaces elastic stress is present, which is minimized by forming such broken morphologies. *OV*

FORCE SPECTROSCOPY

A catenane in action

Chem. Sci. http://doi.org/rhn (2014)

Catenanes are mechanically interlocked molecules that are of interest in the development of synthetic molecular machines because of their large conformational flexibility and range of dynamic response. Probing the submolecular interactions and kinetics of catenanes is challenging because it is difficult to couple the molecules to single-molecule characterization techniques without significantly perturbing the system. David Leigh, Anne-Sophie Duwez, Charles-André Fustin and colleagues have now shown that single-molecule force spectroscopy can be used to study the intramolecular dynamics of the two macrocycles in a [2]catenane molecule.

The researchers — who are based at the Université catholique de Louvain, University of Liège and the University of Manchester — first attached a polymer chain to each of the macrocycles in the [2] catenane. One of these chains was adsorbed on a surface, whilst the other was picked up by the tip of an atomic force microscope. The microscope tip was then slowly pulled away from the surface and the restoring force of the system measured; this force is directly related to the mobility of the two macrocycles.

By carrying out measurements in different solvents, the team show that the technique can identify 'locked' and 'unlocked' catenane rings — in a nonpolar solvent the motion of the rings is constrained by hydrogen bonds between them, whereas in a polar solvent the rings can freely rotate and assume an entropically favoured coiled conformation. *AM*

DRUG DELIVERY

Kind to the skin

ACS Nano http://doi.org/rhp (2014)

Turning laboratory research into real-world applications is a significant challenge. For nanoparticle-based drug delivery, the development of robust formulations of nanotherapeutics with minimal toxicity is an important step towards this goal. Weiwei Gao and colleagues at the University of California, San Diego and Tsinghua University now show that a robust, non-toxic formulation for topical antimicrobial delivery can be created by incorporating nanoparticle-stabilized liposomes into a hydrogel.

Decoration with gold nanoparticles stabilized the biocompatible liposomes and prevented liposome fusion before reaching the bacterial target. However, a sufficient amount of the liposome surface was still exposed to allow bacterial toxins to access the surface and trigger cargo release from the liposomes. Integration into the hydrogel preserved the structural integrity of the nanoparticle-stabilized liposomes and also allowed them to be controllably released by changing the concentration of the hydrogel crosslinker. Using *Staphylococcus aureus* bacteria as a model, the researchers showed that, once released from the hydrogel, the liposomes could fuse with the bacterial membrane in a pH-dependent manner, with a more acidic environment increasing the fusion activity.

When Gao and colleagues tested their hydrogel formulation on the skin of mice, they observed no toxicity or adverse reactions, with the hydrogel-treated skin displaying the same good health as the control after seven days of application. *SB*

QUANTUM COMMUNICATION

A different spin on diamond

Nature Commun. **5,** 3328 (2014)

The most studied defect in diamond is the nitrogen–vacancy (NV) centre, which consists of a nitrogen impurity atom located in the vicinity of a carbon vacancy. The spin of an electron associated with an NV centre has a long coherence time and can be manipulated by photons. These two properties make NV centres good candidates for quantum communication devices.

One problem with NV centres is that their optical emission is intrinsically weak. A promising alternative is the silicon–vacancy (SiV) centre in diamond, which has much stronger emission. So far, however, it has been difficult to detect an optical emission from SiV centres associated with a specific state of the electron spin. This is principally due to spin mixing in the ground state of the electron. Now, Mete Atatüre and colleagues at the University of Cambridge and institutes in Germany, Switzerland and Austria have succeeded in tagging optical emission lines from a negatively charged SiV centre with the electron spin states.

Measurements of the fluorescence of the SiV^- centres revealed two peaks associated with the ground state of the electron and two peaks associated with an excited state. These peaks were split into quadruplets when a magnetic field was applied, as would be expected for a spin-1/2 electron. When a laser excites electrons of a specific spin configuration to the highest energy state, the optical emission shows a relaxation to a lower excited state before the electron decays to the ground state. The decay to the ground state does not conserve the spin perfectly due to misalignment of the magnetic field with the natural magnetization of the SiV^- centres. However, this could be improved by changing the growth conditions of the samples. *FP*

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