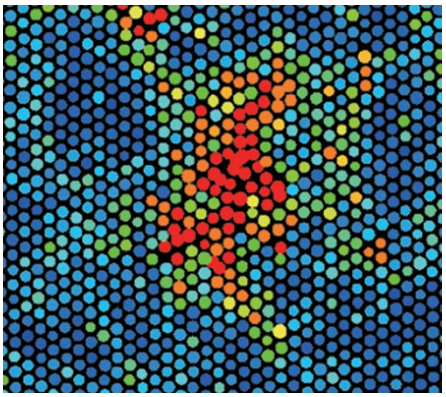
Defect-less melting

Science **338,** 87–90 (2012)



It has been commonly assumed that a crystal heated above the melting point starts to melt through the formation of defects, which diffuse and coalesce to form liquid nuclei (nuclei that reach a critical size grow spontaneously until the whole crystal is melted). But this is not what Ziren Wang and collaborators see in their experiments with crystals of thermoresponsive colloidal gel microspheres, which shrink with increasing temperature. After slowly heating the interior of face-centred cubic crystals with a focused laser, the researchers found with video microscopy that the precursors to the liquid nuclei are instead coordinated circular motions of spheres within regions where the spheres are highly mobile, as had been predicted from recent computer simulations. Interestingly, they also observed that stronger superheating (which caused the colloids to shrink faster) leads to the coalescence of liquid nuclei, which quickly acquire a spherical shape to minimize the liquid–crystal surface tension. The researchers' set-up should lead to a better understanding of melting dynamics and further challenge classical nucleation theory. *PP*

Enzyme catalysis

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The use of surfactant molecules to stabilize aqueous–organic biphasic systems, including emulsions, is a dynamic process involving the interchange of surfactant molecules at the interface. If an emulsion is stabilized using colloidal nanoparticles, namely a Pickering emulsion, however, the nanoparticles are absorbed in a permanent manner at the interface. As a result of their high stability, Pickering emulsions have several practical advantages in enzymatic biphasic reactions. Now, Jan van Hest and colleagues have shown that polymersomes — vesicles formed from amphiphilic block copolymers — can be used to form Pickering emulsions in which enzymes can be either located in the aqueous phase or within the lumen of the polymersomes, and then used to catalyse esterification reactions. The enzyme's specific activity was highest when encapsulated within the polymersomes and was maintained at 89% following eight reaction cycles, when using toluene as the organic solvent. In future studies, the many distinct compartments within this polymersome-based Pickering emulsion could be exploited to load different enzymes and perform a cascade of organic reactions. *AS*

Frosty reaction

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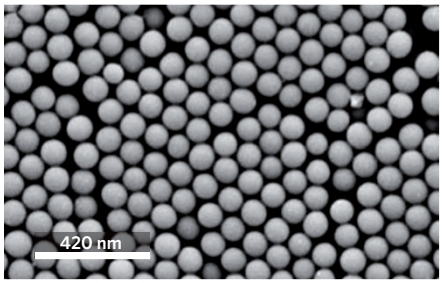
The formation of frost on solid surfaces limits the performance and safety of many technologies, most notably in aviation. Significant efforts have therefore focused on developing so-called icephobic surfaces that slow down or even suppress the formation of ice. However, their performance is strongly affected by environmental conditions such as humidity and shearing gas flow and, as Dimos Poulikakos and colleagues now demonstrate, also the thermal conductivity of the surface. The researchers examine the physics of ice formation in supercooled water droplets on different surfaces, and show that their evaporation — which starts explosively as a result of the latent heat released on impact — generates a condensation halo around each droplet, which in turn crystallizes into ice. Poulikakos and co-workers establish that the size of the frost halo depends, through a delicate balance between heat diffusion and vapour transport, on the thermal conductivity of the substrate: the droplets forming on a polymer surface have larger halos than those on titanium and copper, suggesting that good thermal conductors may be effective in minimizing ice formation and frost propagation. *AT*

Particle perfection

Nature Commun. **3,** 1088 (2012)



The structure and optical properties of π-conjugated polymers can be widely tuned though the choice of appropriate monomers for their synthesis. This versatility and easy processability make these polymers useful base materials for thin-film optoelectronic devices. However, preparation routes for conjugated polymer nanoparticles, which could be used in photonics or as biocompatible alternatives to inorganic nanoparticles for biomedical applications, have generally suffered from a large distribution of particle sizes, commonly referred to as polydispersity. Joris Sprakel and co-workers now report a synthesis scheme for monodisperse nanoparticles made from a range of conjugated polymers. They have adapted the Suzuki–Miyaura cross-coupling reaction — one of the most important routes for the synthesis of such compounds — to a dispersion polymerization process that enables the preparation of particles with well-defined sizes, tunable fluorescence wavelengths and controllable shape. The researchers demonstrate their self-assembly into a photonic crystal and show that the particles can be functionalized with carboxylic acid groups that allow for further coupling reactions for bioimaging. *CM*

Rust shines in new light

Nature Commun. **3,** 1035 (2012)

Electrical cars, wind machines, computer hard drives and most electrical motors require permanent magnets to operate. These are typically made of neodymium–iron–boron alloys, because of their large magnetocrystalline anisotropy and saturation magnetization. However, the magnets use considerable amounts of increasingly expensive rare-earth compounds such as neodymium and dysprosium, thus alternatives are strongly sought after, but with little success so far. Shin-ichi Ohkoshi and colleagues now demonstrate that a relative of common rust could solve this problem. Doped with a few per cent of rhodium, the ferrite $Rh_xFe_{2-x}O_3$ is shown to have a very large coercive field of up to 31 kOe, and shows good microwave absorption as well as magnetic rotation properties that are of interest, for example, in wireless communication applications. Furthermore, the high coercive field could be useful for information storage applications, where it may allow the reduction of the area necessary for a stored bit. Although rhodium may not be a low-cost material either, the relatively small quantities required still promise a new future for magnetic ferrites. *JH*

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