Marbles lost

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'Liquid marbles' are droplets of water, stabilized by a layer of highly hydrophobic particles at the air–water interface, which can be rolled and even bounced. Dupin and co-workers introduce an extra dimension to these fascinating materials, by creating stimulus-responsive liquid marbles. The team stabilize their water droplets with polystyrene latex nanoparticles that have a poly(tertiary amine methacrylate) macromonomer outer layer. At low pH, this outer layer is protonated, making it hydrophilic, so the latex nanoparticles disperse in aqueous solution and no marbles can be made. However, under alkaline conditions the outer macromonomer is deprotonated, making it hydrophobic. When the latex particles are dried from a pH 10 solution and 10-μl droplets rolled over the resulting powder, the droplets are coated, forming liquid marbles. The marbles remain intact when resting on a solid surface or even floating on water at neutral or alkaline pH, only destabilizing as the water inside the marbles evaporates. By contrast, when the marbles are floated on low-pH solution, they disintegrate immediately.

Tunable compartments

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Miktoarm star polymers, that is, polymers with more than three polymeric arms, are particularly promising as membrane structures or for multicomponent transport. Axel Mueller and colleagues demonstrate that crosslinking the bulk structure of miktoarm star terpolymers results in polymeric, multicompartmented cylinders, with the compartments being distributed parallel to the cylinder main axis. The poly(2-vinylpyridine) compartments bind inorganic nanoparticles via supramolecular coordination, which results in hybrid biaxial nanowires that are tunable with respect to the distribution of the nanoparticles in the cylinders' corona. Moreover, the extent of compartmentalization can be tuned by solvent polarity. Such tunable structures allow the conductance of two signals in two directions within the same molecular device, and could be ideally suited as artificial nerves or for nanoscale electronics applications. With improved responsive behaviour, such complex architectures could also prove attractive as responsive junctions or sensors by switching from a biphasic to a monophasic nanowire.

Light-induced motion

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Harnessing sunlight for practical use is common practice, for example, photovoltaics for electricity production and water-splitting to yield hydrogen and oxygen. However, many systems are costly, often involving light conversion into an intermediate that is then used to produce the required output. By exploiting thermal surface-tension effects, Jean Frechet and co-workers have overcome the need for multiple steps, demonstrating the propulsion of solids on the surface of water using either sunlight or 785-nm laser light. The team attached vertically aligned carbon nanotube forests to one face of a polydimethylsiloxane block. The forests absorb more than 99.9% of sunlight and the subsequent relaxation of electrons converts the light to heat, producing a thermal gradient on the water surface. The result is linear motion across the surface with speeds of up to 8 cm s^{-1}. By altering the position of the light on the absorbing surface it is possible to control the direction of motion. Furthermore, by changing the shape of the polymer block, rotational motion was achieved.

Magnonic spin-offs

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Photonic crystals, where periodic variations of dielectric constant affect the propagation of light, are well-known structures. Magnonic crystals on the other hand, where periodic variations in magnetic properties alter or even forbid the propagation of spin waves, are much less common. Nevertheless, magnonic crystals are of interest as their capability to modify and control the propagation of spin waves may be important for spintronics applications. Previous attempts to fabricate magnonic structures have been mostly limited to etching grooves and holes into magnetic materials. Zhi Kui Wang and colleagues now follow a different approach, and fabricate one-dimensional composite structures that exhibit a full magnonic bandgap where spin-wave propagation is suppressed. The devices consist of 250-nm-wide alternating stripes of permalloy and cobalt. Under the application of a magnetic field, the band structure of the magnonic crystal can be shifted, thus allowing control over the crystal's properties. The versatile nature of these magnonic crystals, which are based on common metals, opens the use of such composites for spintronics applications such as waveguides or spin-wave filters.

Weird magnetism

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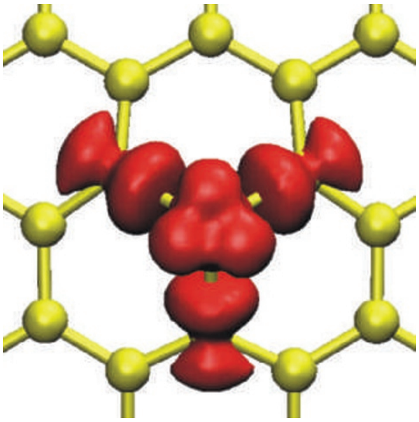

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Unexpected things can occur when you mix different elements. This is certainly what Arkady Krasheninnikov and his collaborators found while investigating what happens when transition metal (TM) atoms are embedded in the carbon lattice of graphene. They used first principles calculations to study the stability and magnetic properties of a graphene structure with a TM atom placed in either a single or a double carbon vacancy. The bonding of the inserted atom is always very strong, and there are some real surprises in the magnetic behaviour. For example, an iron atom in a single vacancy is not magnetic, whereas a copper or a gold one is. The team showed that the behaviour can be explained by the local orbital modification involving the sp^2 hybrid carbon orbitals and the s, p and d orbitals of the TM atoms. Knowledge of the properties of such systems could be particularly interesting for application of graphene in spintronics or in catalysis.