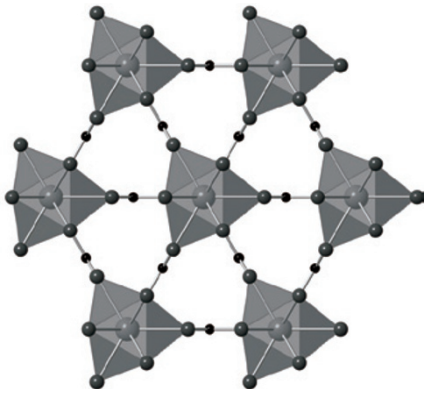
Cool MOFs

Adv. Mater. http://doi.org/f2df2s (2013)



Magnetocaloric materials have latterly been the focus of intense research as the basis for efficient refrigeration technologies. By taking advantage of the thermodynamic changes associated with the varying magnetization of a material exposed to a magnetic field, the best magnetocalorics require suitable intrinsic properties that maximize the thermal response associated with the change in magnetization. In this regard, gadolinium is often used as a starting point as it has no orbital angular momentum associated with it, therefore maximizing the entropy for each spin. However, achieving a large bulk magnetocaloric effect requires a careful compromise between maximizing the density of magnetic ions present in a material, yet ensuring they are weakly coupled so that there is no magnetic order when the field is turned off. Now, Marco Evangelisti and colleagues show this can be efficiently done in gadolinium formate ($Gd(HCOO)_3$), a metal–organic framework (MOF) in which the Gd ions are linked by light formate ligands. The low-temperature magnetocaloric effect they uncover is enormous, and compares favourably to benchmark magnetocalorics such as $Gd_3Ga_5O_{12}$ (GGG). Cool things may therefore be in store for MOFs. *AT*

Multifunctional graphene

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Researchers have demonstrated that graphene can improve the performance of a broad range of devices thanks to its unique optical, chemical, thermal and mechanical characteristics. Now, Seungae Lee and co-workers take advantage of all these properties simultaneously and demonstrate that graphene can also be suitable as an encapsulating material. The authors disperse graphene sheets at a low concentration in a silicone resin and use this blend to cover inorganic white light-emitting diodes. The brightness of this light source is not impaired by the graphene nanosheets, because of their high optical transmittance; rather, the device benefits from the blend cover, which shows an improved thermal conductivity, a lower thermal expansion coefficient, and reduced permeability to moisture and hydrogen sulphide gas. The enhanced protection from external agents and faster heat dissipation increase the long-term stability of the diode: indeed its luminous flux remains almost unchanged over 1,000 h of continuous operation. *LM*

Branches reduce blinking

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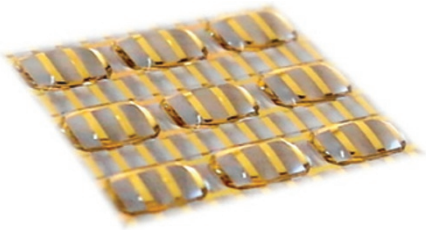
Organic fluorophores are commonly used as probes in fluorescence studies of biological systems. Their application, however, is often hampered by their photostability. To overcome this, anti-fading agents or oxygen-scavenging enzymes can be added but these may introduce toxicity issues. Now, Steven Zimmerman and colleagues have designed a single-molecule, far-red fluorescent probe that shows longer-lasting fluorescence emission and more stable, and reduced blinking emission than the cyanine fluorophore, Cy5. This enhanced emission behaviour is observed in the absence of anti-fading additives but in the presence of oxygen-scavenging agents. The probe comprises a water-soluble polyglycerol dendritic structure covalently coupled to a ring-fused boron-containing fluorophore and a targeting moiety such as biotin. The non-blinking behaviour of the dendritic fluorophore is attributed to the ring-fused arrangement of the boron-containing moiety and, to a lesser extent, the shielding nature of the dendritic arm. Preliminary *in vitro* experiments demonstrate the imaging of the microtubule network of mouse embryonic fibroblast cells as a result of neutrAvidin–biotin interactions. *AS*

Multiplexed for detection

Nature Commun. **4,** 2001 (2013)



Multiple disease markers in clinical samples can currently be detected with arrays of electrochemical silicon-based biosensors. However, the degree of readouts that can be made in parallel is limited by the complexity of integrated active electronics, as the electrical contacts of each sensor have to be addressed independently. Brian Lam and colleagues have now designed and fabricated solution-based circuits that can increase the level of multiplexing of electrochemical biosensors substantially. They used glass instead of silicon as a substrate, and lithographically patterned channels routed with reference and counter-electrode layers electrically insulated from subsequently electrodeposited tree-like working microelectrodes (also within the channels). A conductive solution in the channels makes contacts between the electrodes to form transient circuits. After functionalizing the working microelectrodes with pathogen-specific peptide nucleic acid probes, the researchers used these solution-based circuit chips to parallelize the quick detection and classification of 30 probes for pathogenic bacteria and antibiotic-resistance markers in unpurified samples. These chips should offer better scalability and be cheaper than standard molecular testing methods. *PP*

Coherent absorption in graphene

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Graphene, a truly two-dimensional gapless semiconductor, has been recognized as a revolutionary material for optoelectronic applications. Several uses of graphene have been proposed in various devices, such as transparent electrodes, ultrafast lasers, polarizers and photodetectors. The low absolute value of the absorption of graphene (2.3% of the incident light is absorbed in a graphene layer) limits the photocurrent efficiencies of graphene-based photodetectors. Therefore, one of the challenges is to enhance its optical absorption. Now, Luis Martín Moreno, Jaime Gómez Rivas and colleagues experimentally demonstrate a broadband enhancement of the light absorption in graphene over the whole visible spectrum. This enhanced absorption is obtained in a multilayer structure by using an attenuated total reflectance configuration and is explained in terms of coherent absorption arising from interference and dissipation. The interference mechanism leading to the phenomenon of coherent absorption can be precisely controlled by varying the refractive index and/or thickness of the medium surrounding the graphene. *KT*

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