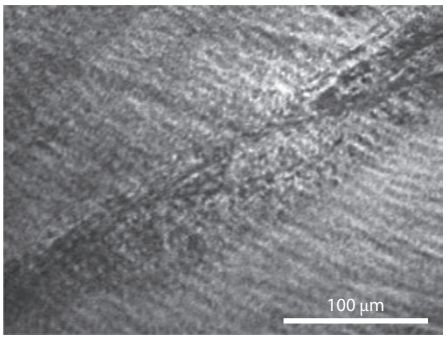
Flat and functional

Nature Chem. **6,** 468–476 (2014)



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Many synthetic methods used to make two-dimensional carbon nanosheets do not permit the introduction or retention of functional groups on their surface. The need for functionalization, however, is often paramount for the processability of the materials or for a particular application. Now, Holger Frauenrath and colleagues report the synthesis of extended, functional carbon nanosheets by the carbonization of self-assembled monolayers of amphiphilic molecules at the air/water interface. The amphiphiles contain hexayne segments with an ester head group and an alkyl chain tail, and the close-packing arrangement of the hexayne and alkyl chains within the monolayer is such that crosslinking under ultraviolet irradiation and at room temperature produces a greater than 80% sp^2-hybridized carbon nanosheet. This extent of conjugation is similar to that achieved with high-temperature annealing conditions, however, by using this self-assembled monolayer route, the functionalized hydrophilic surface can be retained. The carbon nanosheets, which have a thickness of 1.9 nm, are also demonstrated to be effective substrates, with low background contrast, for transmission electron microscopy imaging of hydrophilic gold nanoparticles. *AS*

Timeless amber

Phys. Rev. Lett. **112,** 165901 (2014)

The low-temperature behaviour of amorphous, glassy materials differs markedly from their ordered, crystalline counterparts. A celebrated example of this difference is the so-called boson peak, an enhancement in the density of vibrational states measurable in the specific heat of glasses. Its precise origin is a matter of some debate. Put simply, are anomalous features such as the boson peak intrinsic to glasses, or are they eventually supressed by sufficiently strong annealing or ageing processes? Tomás Pérez-Castañeda and colleagues attempt to address this question by studying a model glass that has aged far longer than any system accessible in the laboratory: 110-million-year-old amber from the cave of El Soplao in northern Spain. They measured the specific heat of pristine amber, and examined how this changes when it is thermally annealed in different ways, a process that in effect erases its 110 million years of cooling history. Within experimental error, all the amber samples display the same specific heat below 1 K, suggesting that the boson peak is indeed an intrinsic property of the glassy state. *AT*

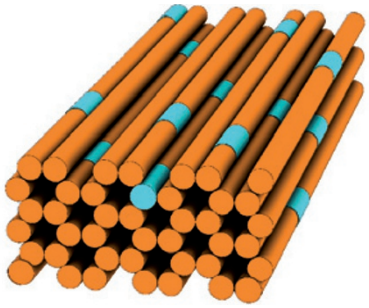
Exciton photonics

Nano Lett. http://doi.org/snp (2014)

Plasmonics, the revolutionary field that merged photonics, electronics and nanotechnology, has enabled the possibility of controlling light at the nanoscale. Excitons are now emerging as an alternative means to allow similar nanoscale manipulation capabilities of electromagnetic waves. A variety of materials that can sustain exitonic long-range waves able to couple with light, called surface exciton polaritons (SEP), have been demonstrated in the past 40 years. Now, Bill Barnes and co-workers have proposed the possibility of exciting localized SEP modes, which have so far been the missing ingredient for excitonic light manipulation at the nanoscale. By studying dye-doped polymers, they show the existence of a negative real permittivity region and theoretically predict that these nanostructured materials can support localized SEP modes that induce field-enhancement and subwavelength field confinement, the two fundamental features that have made plasmonics so successful. *ON*

Base-pair quality check

Nature Commun. **5,** 3691 (2014)



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Watson–Crick base paring offers enormous flexibility in the design and synthesis of structurally complex, self-assembled nanostructures. Yet improvements in the assembly protocols are limited by difficulties in measuring with accuracy the quality of the resulting nanostructures — which can be defined by the fraction of unpaired DNA bases (the lower the better) — with standard microscopy techniques. Klaus Wagenbauer, Christian Wachauf and Hendrik Dietz now show that the amount of unpaired bases in DNA-origami nanostructures can be quantified with precision by synthesizing proper circular DNA sequences that form base pairs with the unpaired DNA 'defects' — and thus act as probes for them. By labelling the DNA with two types of fluorescent tag (a 'reference' tag for the self-assembled structure and another for the defects) and comparing their fluorescence intensities, the researchers worked out the number of unpaired DNA bases created by strand omission in various multilayer DNA-origami objects. Moreover, they used this information to refine the assembly protocols and improve the quality of the self-assembled origami nanostructures. *PP*

Temporary bonds

Nature Commun. **5,** 3586 (2014)

In less than five years, solar cells based on organo-lead trihalide perovskites have surpassed the photovoltaic performance of organic semiconductors and quantum dots, and are reaching the efficiency of silicon solar cells. Some mechanisms leading to this improved power-conversion efficiency have been identified, yet the nature of the photoexcited species generated in this material is still under investigation. Annamaria Petrozza and colleagues now show that, when exposed to normal sunlight intensity, the excitons generated in the perovskite layer readily separate into free charges. They estimate the excitons' binding energy by means of absorption measurements and find that, at room temperature, almost all the excited species are split into electrons and holes that can be directly collected at the electrodes of the solar cell. Because the fraction of bound excitons increases when the perovskite layer is irradiated with higher light intensity, the researchers suggest that this material may also prove effective in optoelectronic applications in which a high number of bound species is required. *LM*

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