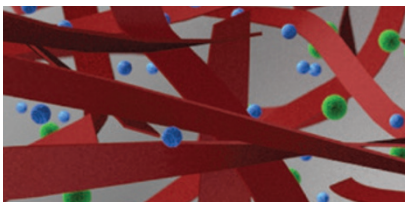
Green tea therapy

Nature Nanotech. http://doi.org/v7k (2014)

In most drug delivery systems comprising nanomaterials or macromolecules as carriers, the carrier entities fulfil the role of targeting the associated therapeutic drug to the required site in the body, but provide no therapeutic effects themselves. Now, Joo Eun Chung, Motoichi Kurisawa and colleagues synthesize micellar nanocomplexes in which antitumour proteins are self-assembled with macromolecular derivatives of an ingredient of green tea known to have anticancer properties, and show that the resultant nanocomplexes cause a considerably higher anticancer effect *in vivo* than the free antitumour protein and drug-free micellar complexes. The binding properties of the green tea derivative, (−)-epigallocatechin-3-*O*-gallate (EGCG), with proteins, are the driving force for the assembly of the micellar nanocomplex. The core of the nanocomplex contains oligomerized EGCG assembled with the antitumour protein, Herceptin, and the shell consists of poly(ethylene glycol)–EGCG. The nanocomplex remains in blood circulation for a longer time period as well as demonstrating a 2.3-fold higher accumulation within the tumour compared with free Herceptin. *AS*

Hydrogels evolve hydrogen

Nature Chem. http://doi.org/v7m (2014)



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The fabrication of artificial photosynthetic systems by taking inspiration from complex cellular structures, for example, from plant chloroplasts, offers the opportunity to produce light-harvesting materials with energy conversion properties. With this in mind, Samuel Stupp and colleagues prepare a hydrogel scaffold that incorporates light-absorbing chromophores and nickel-based catalysts and show its capability for photocatalytic hydrogen production. The hydrogels are formed from the addition of salts or the positively charged catalyst to aqueous solutions of supramolecular ribbons of anionic amphiphilic chromophores. The screening effect of the positively charged catalyst promotes the two-dimensional crystallization of the amphiphilic chromophores and results in strong electrostatic coupling between the chromophores and catalyst. In the presence of ascorbic acid, which acts as a proton source and sacrificial electron donor, the photocatalytic production of hydrogen is observed. Light, catalyst, ascorbic acid and the amphiphilic chromophores, together with the hydrated state of the gel, are all required for hydrogen evolution. This co-localization of light-harvesting moieties and redox catalysts within a hydrogel represents an exciting step forward for bioinspired soft materials. *AS*

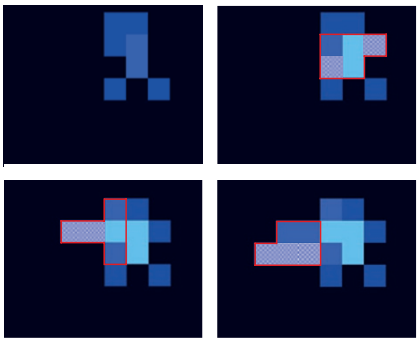
Ultrafast plasmonic lasers

Nature Phys. http://doi.org/v7p (2014)

Plasmonic lasers have recently been explored as a means to enhance lasing performances. They take advantage of a metallic cavity that can sustain surface plasmon polariton (SPP) waves to achieve a higher optical confinement and feedback. Even though SPPs can generate highly focused optical excitations at much faster timescales than their photonic counterparts, at present the potential application of plasmonic lasers in everyday technology is limited. In particular, parasitic cavity losses, which are connected to the degree of optical confinement, have an effect on the laser threshold and dynamics. Now, Rupert Oulton and co-authors present a hybrid plasmonic laser that operates at room temperature and shows ultrafast lasing characteristics. This is achieved by matching the energy of the excitons in a ZnO nanowire to the surface plasmon frequency of a Ag-based plasmonic laser in the ultraviolet. Accelerated lasing dynamics were demonstrated when compared with standard ZnO nanowire lasers, with pulses shorter than 800 fs. Even though this supreme speed might not allow the build-up of a population inversion, the improved performance compared with photonic devices clearly shows the potential of plasmonic lasers as an alternative means to obtain ultrafast lasing. *ON*

Cumulative-area tracking

Nature Commun. **5,** 5123 (2014)



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The tracking of single molecules, most often achieved through chemically attached fluorophores, is essential to the study of subcellular dynamics and soft polymeric materials. Many techniques exist to accurately localize and track single molecules, yet the tracking of their shape and size as they diffuse in their environment has for the most part remained experimentally inaccessible. Now, Satoshi Habuchi and colleagues describe a method that tracks the cumulative area occupied by a diffusing molecule. The method is able to provide information about molecular size and frequency of conformational changes in addition to translational diffusion. By measuring the diffusion coefficients in two dimensions and the conformational dynamics of double-stranded DNA molecules of various lengths and topologies, the researchers show that the cumulative-area technique is more accurate at determining single-molecule diffusion coefficients than conventional fluorescent-based single-molecule tracking methods. The researchers state that with further development their approach could achieve three-dimensional area tracking, and that it could be combined with super-resolution microscopy and multicolour imaging for better tracking of single molecules in complex soft-matter and biological systems. *PP*

Cold transport at room temperature

Nature Commun. **5,** 4745 (2014)

By decreasing the size of a material down to the nanometre scale, the energy levels that can be occupied by electrons are split into well-defined states. Such control of the energy levels is key for the realization of devices based on the conduction of single electrons, but is hampered by lattice vibrations that provide additional thermal energy to the electrons. Pradeep Bhadrachalam and colleagues now show that the effects of thermal excitations on electron transport can be suppressed by combining the discrete energy levels of a quantum dot with those of a quantum well. The latter material acts as a filter for the charges injected from an electrode into the quantum dot, and allows efficient collection at the second electrode only of those electrons that are not thermally excited — that is, cold electrons. A single-electron transistor based on this energy-filtering mechanism shows clear signatures of electron transport through discrete single-electron levels up to 295 K. *LM*

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