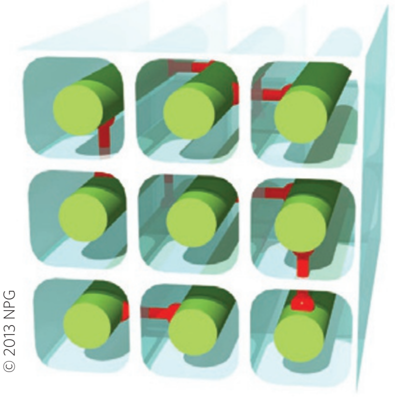
Pristine polymers

Nature Chem. http://doi.org/kpj (2013)



Aligning linear polymer chains in a crystalline-like manner is synthetically challenging but may result in enhanced mechanical and thermal properties. Susumu Kitagawa and colleagues now report the uniaxial alignment of atatic polystyrene to form a pseudo-crystalline arrangement using porous coordination polymers (PCPs) as host materials. The PCPs are functionalized with bifunctional molecules that crosslink the polystyrene chains as they form within the channels of the porous host (pictured). When the PCP matrix is selectively removed, highly aligned polystyrene with a defined distance between chains, is obtained. The polystyrene forms shape-replicas of the cubic PCP crystals, indicating that polymerization is limited to within the porous crystals. In comparison with other alignment methods that rely on weaker interactions between chains, the covalent nature of the crosslinks imparts structural stability on the polymer when exposed to heat and organic solvents. The cross-polymerization of methyl methacrylate was achieved by the same route, demonstrating the extension of the method to other radical vinyl monomers. *AS*

Cellular logic and memory

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By taking advantage of specific interactions between genes and proteins, living cells with synthetic genetic circuits that either retain memory of an activating event or perform cellular logic — for example, detecting a certain molecule in the environment and generating a specific response — can be created. Now, Piro Siuti *et al.* report a strategy to assemble cellular circuits that combine both logic and memory. They built all possible two-input logic functions in living *Escherichia coli* cells by assembling a variety of DNA-based modules (promoters, terminators and outputs of gene expression) that control the production of green fluorescent protein (output) as a function of the expression of two serine recombinases — enzymes that can cut, flip or insert strands of DNA depending on the orientation of two DNA recognition sites. The expression of the recombinases is activated by two signalling molecules (inputs), and alters the gene modules permanently. Hence, the recombinase-based logic gates can maintain memory of input events (over tens of generations in cell division), and also over time, therefore also making sequential logic possible. *PP*

Polarizing europium

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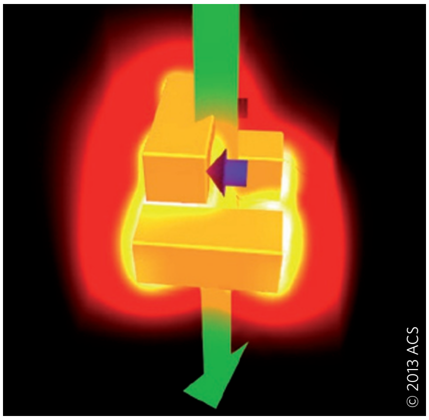
The europium chalcogenides (EuO, EuS, EuSe and EuTe) have long been known for their simple rock-salt structure as well as their rich magnetic and magneto-optic properties. They are also wide-bandgap semiconductors that, in combination with their magnetism, makes them potentially interesting for spintronic applications. As for most ferromagnetic semiconductors, however, ensuring they remain magnetic up to room temperature is a stumbling block. Spiridon Pappas *et al.* now present a possible way for achieving this. The trick is to take advantage of their polarizability in proximity to a ferromagnet. By fabricating multilayers consisting of cobalt and EuS they observe, by means of X-ray magnetic circular dichroism, a significant magnetic signal associated with the europium ions at room temperature. The magnetic response is a direct signature of substantial spin-polarization in the EuS, and suggests manipulating both the electron spin and its charge may be feasible in these materials in the future. *AT*

Plasmon radiance

Nano Lett. **13,** 497–503 (2013)



Interference effects, such as Fano resonances, in typically lossy plasmonic excitations can give rise to long radiative lifetimes, combining the advantages that surface-plasmon modes offer in terms of strong nanoscale light confinement with narrow spectral linewidths. Such excitations are promising for nanophotonic applications such as sensing, lasing and switching. Their coupling to incident radiation, also known as radiance, determines their optical properties. Olivier Martin, Peter Nordlander and colleagues now show that the radiance of plasmonic modes can be classified into three distinct regimes. In the weak coupling regime, the linewidth exhibits remarkable sensitivity to the dielectric environment. The researchers show that geometrical displacements of the order of a few ångströms could be detected optically by measuring the plasmonic radiance. In the intermediate regime, the electromagnetic energy stored in the mode is maximal, with large electric-field enhancements that can be exploited for surface-enhanced spectroscopy. In the strong coupling regime, the interaction results in hybridized modes with tunable energies. *KT*

Auger cools down

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Fluorescence intermittency, also known as blinking, has hampered the use of semiconductor colloidal nanocrystals as reliable photon sources. Several detrimental blinking mechanisms, such as the Auger process that involves a non-radiative energy transfer from a photoexcited electron–hole pair to a third charge, contribute to lowering the efficiency of nanocrystals. Javaux *et al.* now demonstrate that the Auger process can be deactivated by controlling the temperature of these colloidal nanoemitters. CdSe nanocrystals surrounded by a thick CdS shell preserve a charged negative state when their temperature is lowered from 300 K to 30 K. Nevertheless, the presence of such charge does not affect radiative recombination below 200 K. Indeed, the small energy offset in the conduction band and the confinement of charges in these structures are tuned by temperature; only above 200 K can electrons delocalize in the shell and interact with the sharp potential of the outer surface, a necessary condition to activate the Auger process. The importance of energy-band engineering for the synthesis of highly efficient nanocrystals is further demonstrated. *LM*

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