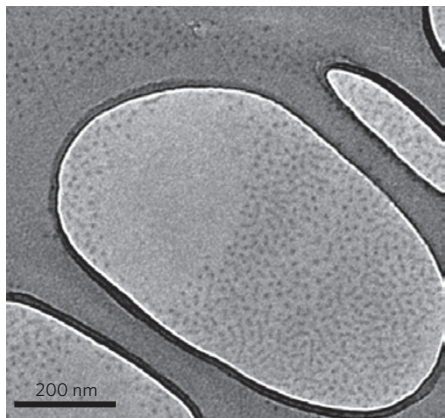


## Radical segregation

Nature Chem. <http://doi.org/hvv> (2012)



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Confining reactants in a separate environment to the bulk is a well-established phenomenon in nature that scientists have successfully mimicked in different syntheses. Templated synthesis has also passed from the biological domain to synthetic small-molecule syntheses and polymerizations in recent years. Now, Rachel O'Reilly and colleagues have combined confinement with templating methods to devise a biomimetic approach that achieves unprecedented control over radical polymerization without using living polymerization techniques. This high level of control — which is evident by the low polydispersity ( $\leq 1.08$ ) and high molecular weight (up to  $\sim 400,000 \text{ g mol}^{-1}$ ) of the resultant polymers — is achieved by segregating the propagating radical within discrete micellar cores. The dynamic micelles (pictured) are formed from thymine-containing block copolymers, which template and segregate complementary adenine-containing vinyl monomers inside the cores. The segregation of the radical significantly reduces the bimolecular termination step compared with a similar reaction in bulk solution. This ability to manipulate individual

chains by segregation could allow for further control of the polymeric structure, such as the monomer sequence. AS

## Paving the way for electrons

Science **336**, 327–332 (2012)

Organic solar cells and light-emitting diodes are typically based on electrodes with dissimilar work functions. Whereas the high work-function electrode enables hole injection or extraction, access to the lowest unoccupied molecular orbitals in the organic semiconductor layer and electron transport is mediated by the electrode with the lower work function. However, electrodes with low work functions are not easy to prepare. Suitable materials are often unstable, and surface functionalization schemes require tailored chemistry. Yin-hua Zhou and colleagues now report a general surface modification scheme that can lower the work function of a range of electrode materials by more than 1 eV, facilitating electron injection. It is based on polyethylenimine-type polymers, which can modify energy-level alignment through charge transfer and intrinsic molecular dipoles. The polymers are solution processable and stable at conditions typical of roll-to-roll processing schemes. The researchers demonstrate the functionality of the modification layers in organic solar cells, diodes and n-type field-effect transistors, and find that they are stable for more than four weeks. CM

## Three times winner

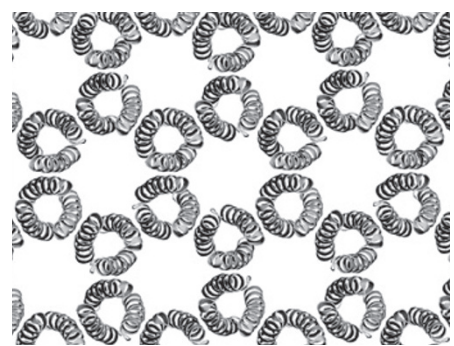
Nano Lett. **12**, 2067–2070 (2012)

Graphene is a promising material whose high mobility makes it of interest for high-frequency electronic applications, although the lack of a bandgap and the ambipolar device characteristics are still challenges to be overcome. Turning such properties into virtue, Hong-Yan Chen and Joerg Appenzeller have now demonstrated a graphene-based

electronic frequency tripler. The device is based on two graphene transistors coupled together. If biased appropriately, such a tripler converts an oscillating voltage applied to both transistors simultaneously into a frequency-tripled signal across both transistors. In most cases the signal of a frequency tripler still contains a large contribution at the fundamental frequency, which means the spectral purity lies below 15%. For the graphene triplers demonstrated here, however, the spectral purity at a frequency of 600 Hz is 70%, making this a promising demonstration of using graphene's unique properties for novel electronics devices. JH

## De novo protein crystal

Proc. Natl Acad. Sci. <http://doi.org/hvv> (2012)



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Obtaining crystals of a protein is essential to determining its three-dimensional structure using X-ray diffraction. This entails laborious screening and optimization work to find the conditions that favour crystallization and the acquisition of quality diffraction data. Computational protein design has therefore become an alternative, and in particular a more powerful strategy for designing protein folds. Now, Christopher Lanci and colleagues have succeeded at designing the folded structure of a protein (a three-helix coiled coil) and also the crystal structure it self-assembles into (a layered honeycomb-like lattice with polar orientation of the proteins). Their *de novo* approach involves the design of protein sequences for candidate crystalline structures within a set of physically accessible crystalline arrangements of the protein backbone compatible with the target crystalline structure. It also involves experimental synthesis, searching for crystallization conditions, and characterization of the candidate proteins. The researchers show that the X-ray structure of their designed coiled-coil protein and its computational model agree down to the sub-ångström scale. PP

Written by Joerg Heber, Christian Martin, Pep Pàmies, Fabio Pulizzi and Alison Stoddart.

## Glitters like silver

Nano Lett. <http://doi.org/hvt> (2012)

Semiconductor nanocrystals have the potential to be used in optoelectronic devices, like solar cells or thermoelectric components. Scientists are trying to improve their electrical conductivity by adding charges to them. In bulk semiconductors, additional charges are usually provided by introducing impurity atoms, or dopants, but the task of repeating this procedure with nanometre-size specimens has proved challenging. When Ayaskanta Sahu and colleagues added silver atoms to CdSe nanocrystals they got more than they bargained for. For just two silver atoms in each nanocrystal they observed an unexpected tenfold enhancement of the fluorescence. Based on previous results reporting fluorescence enhancement by positive ions, the team suggested that at low concentration the silver atoms ionize and release electrons in the nanocrystals. The suggestion was confirmed by electrical measurements that showed an electron-enhanced conductivity. Although understanding the exact mechanism will require more work, the demonstration of electron doping represents a milestone in itself. FP