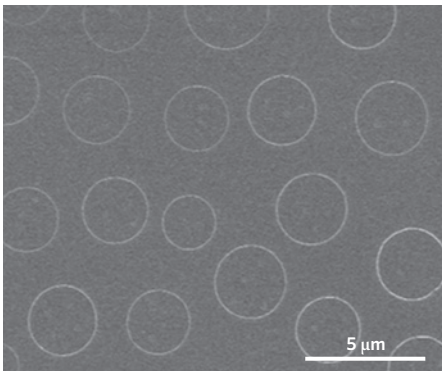
Polymer toroids

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



Polymeric microscale rings with an interior nanoscale space — or more specifically, hollow toroids — have remained a synthetic challenge for chemists. Now, Kimoon Kim and colleagues report the preparation of polymeric toroids (pictured) that retain their shape and mechanical robustness in solution. The toroids are formed from the photopolymerization of rectangular, rigid-core monomers that comprise four alkene functionalities with flexible thiol-containing crosslinkers. Using microscopic techniques, Kim and colleagues show that the structures result from the initial formation of ellipsoidal oligomeric patches that roll-up, in the longitudinal direction, to yield hollow nanotubes. These straight nanotubes bend into arc-shaped structures, and then further growth results in the formation of energetically stable, hollow microrings. The size of the microrings and the cross-sectional diameter of the hollow nanotubes can be controlled by the initial monomer and crosslinker concentrations. Cross-sectional diameters of approximately 40 nm can be achieved and this interior space can encapsulate fullerenes or ferrocene derivatives. Furthermore, the outer surface of the toroids can be decorated with silver nanoparticles. *AS*

Snapping superconductors

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The discovery of iron-based superconductors has inspired chemists and physicists to join forces to optimize their superconducting properties. One promising strategy is to change the chemical composition of the spacer layer between the iron-containing 'superconducting' layers. For example, iron selenide (FeSe) has a bulk superconducting temperature (T_c) of 8.5 K, but when placed in solutions of alkali metals in liquid ammonia it reacts to produce intercalates with T_c of up to 45 K. Now, Stefan Sadlmaier and colleagues present a method to monitor this reaction *in situ*, using time-resolved X-ray diffraction. They identify the metal–ammonia intercalates with increased T_c, but their technique also allows them to show that these are decomposition products from a fleeting phase that is much richer in ammonia. Moreover, they find that the absorption and desorption of ammonia in these intercalates occurs reversibly at room temperature. More generally, these results demonstrate the power of modern diffractometry in characterizing fleeting phases of matter, which should bode well for future studies of superconducting materials. *AT*

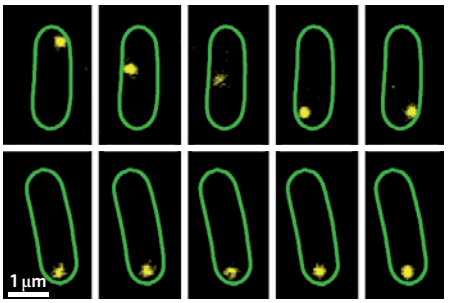
Ultrafast separation

Science http://doi.org/qrx (2013)

To define optimization strategies for improving the light-conversion efficiency in organic solar cells, it is mandatory to understand how electrons and holes photogenerated in bulk heterojunctions can overcome their Coulomb attraction and separate into free charges. Simon Gélinas and colleagues now show that, in about 40 fs, charges can separate at distances larger than 4 nm, thus rapidly reducing their mutual attraction energy below the thermal energy. They studied bulk heterojunctions based on fullerene aggregates blended with small molecules and polymer donors. The authors determined the ultrafast charge motion by correlating the temporal evolution of the absorption spectrum of the blends with the electric field generated by the separating charges. The presence of aggregates in the fullerene domains is essential for creating delocalized band-like electronic states that couple with the wavefunction of the electrons generated in the donor material. This coupling allows electrons to resonantly transfer into the acceptor and undergo long-range motion soon after their photogeneration, without needing excess energy to separate efficiently from holes. *LM*

Glassy cytoplasm

Cell http://doi.org/qrz (2013)



For intracellular processes to work, ions, proteins and bigger components — such as protein complexes and protein filaments — have to be able to move around the crowded environment of the cytoplasm, either through active transport (mediated by cytoskeletal motor proteins) or passive diffusion. Although understanding cytoplasmic passive transport in bacteria — which lack both a proper cytoskeleton and active transport mechanisms for nucleic acids and proteins — is crucial in cellular physiology, seemingly conflicting reports of subdiffusive and normally diffusive transport from both experiments and theory have hindered progress. Now, Christine Jacobs-Wagner and colleagues show that for components of less than 30 nm in size the bacterial cytoplasm behaves as a simple viscous liquid, but that for bigger macromolecules it increasingly behaves as a glass-forming liquid that displays dynamical features akin to those of colloidal glasses. The authors thus provide an explanation for past observations of both normal and anomalous diffusion. They also demonstrate that cellular metabolism fluidizes the cytoplasm by causing perturbations that allow the macromolecules to escape the cages formed by their neighbours. *PP*

Enhancing upconversion

Nano Lett. **14,** 101–106 (2014)

Upconversion photoluminescence (UPL) — a process through which several infrared photons combine to generate one ultraviolet–visible photon — promises to improve the performance of solar cells by harnessing the infrared part of the solar spectrum. In biological imaging applications it would also enhance the detection of the infrared signal that arises from deep biological tissue, which is currently limited by the poor efficiency of photodetectors in this wavelength range. However, to become a technological reality the intrinsic limitation of UPL, namely, the poor conversion efficiency of infrared photons into ultraviolet–visible photons, needs to be addressed. Sun and co-workers now propose a path to overcome this stumbling block. Through the enhancement of the local electric field by surface plasmon polaritons on nanopatterned gold substrates, the authors obtain a significant amplification of both the absorption of infrared radiation and the energy transfer between the ytterbium ions and erbium dopants in doped lanthanide nanocrystals that coat the substrate. Their findings constitute an important step towards achieving more efficient access to the infrared region. *ON*

Written by Luigi Martiradonna, Olivia Nicoletti, Pep Pàmies, Alison Stoddart and Andrea Taroni.