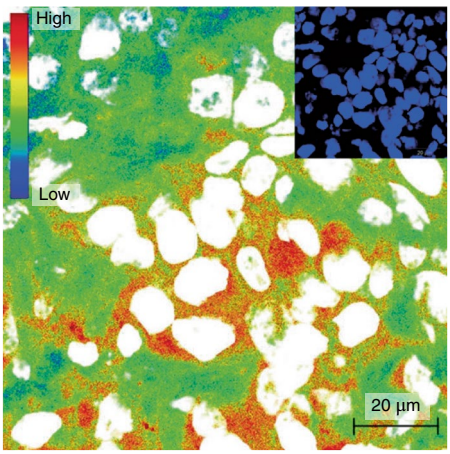
GENE THERAPY

Escorted delivery

Nat. Commun. **10**, 1894 (2019)



Credit: Springer Nature Ltd

Non-viral RNA delivery for gene therapy is often achieved by encapsulating nucleic acid cargoes within nanoparticles. When applied to oncotherapy, however, these nanoparticles can be too big to penetrate the dense tumour microenvironment that characterizes certain tumours and are cleared in the spleen and liver, reducing the efficacy of the treatments.

Watanabe and colleagues design a small Y-shaped molecule consisting of a positively charged polylysine stretch and two polyethylene glycol (PEG) arms. When injected in specific proportions in the bloodstream of mouse models, the molecule associates in a dynamic equilibrium with desired single- or double-stranded RNAs. Tweaking the number of positive charges and the length of the PEG arms allows stabilization of the RNAs via ionic interactions, and modulation of the lifetimes of the complexes that form. Using these chaperones, the authors efficiently deliver therapeutic RNAs to a pancreatic cancer and glioma, showing deep penetration of the RNAs in the tumours and limited accumulation in the spleen and liver. These cancers have so far been challenging to target due to the thickness of the tumour microenvironment and the presence of a tight blood–brain tumour barrier that filters out large nanoparticles. *CP*

https://doi.org/10.1038/s41565-019-0481-3

SELF-ASSEMBLY

A sweet encounter

J. Am. Chem. Soc. **141**, 4833–4838 (2019)

Self-assembled structures of nucleic acids, proteins and saccharides form the backbone of natural systems. Scientists have been able to engineer analogous, but simpler, self-assembly systems made of oligonucleotides and oligopeptides, but self-assembly of oligosaccharide has been hard to achieve. Now, Yu et al. show that certain oligosaccharides, ranging from dimers to hexamers, can form self-assembled nanostructures as well.

The researchers synthesize a series of oligosaccharides with different chemical modifications and length. They observe that structures bonding through a 1,4-glycosidic linkage do not self-assemble, because this kind of linkage limits the conformational degrees of freedom of the oligomer. Instead, 1,6-linked oligosaccharides can give rise to nanosized spheres and needles depending on the length and chemical modifications. Self-assembled structures arise due to the formation of an extended hydrogen bonding network. Contribution of π–π stacking is relevant only if certain organic solvents and certain sample preparation protocols are used. The fluorescence spectra of the oligosaccharides are also consistent with the formation of stacked structures.

Being able to design oligosaccharides with defined self-assembly behaviour adds to the toolkit of bio-inspired materials and sheds light on the intermolecular interactions among saccharides in natural systems. *AM*

https://doi.org/10.1038/s41565-019-0479-x

SENSORS

Surfactant quantification

Anal. Chem. http://doi.org/c5z9 (2019)

Perfluorinated surfactants are harmful, so their quantification in water is necessary. However, the existing ways of surfactant detection are complicated and not environmentally friendly. Now Luo and co-workers reported a simple bubble-nucleation-based electrochemical method to quantify surfactants selectively and sensitively.

They previously reported Pt nanodisk electrodes that are capable of monitoring the electrogeneration of single hydrogen bubbles at the Pt/gas/liquid interface from the drop of the diffusion-limited current in a hydrogen evolution reaction. By scanning the electrode potential, a minimum current value corresponding to the bubble nucleation and formation was reached. The high surface activity of surfactants is known to enable bubbles to nucleate at much lower dissolved H2 level. Then by measuring the peak value, they demonstrate the quantification of surfactant in water. With a preconcentration step, they achieve a limit of detection of 70 ng l^{-1}, the advised value for drinking water. *WS*

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NANOMECHANICAL RESONATORS

Shake the quantum liquid

Nano Lett. http://doi.org/c5z7 (2019)

Nanomechanical resonators are sensitive tools to probe photons, charges or spins in mesoscopic systems, and can operate both in the quantum and classical limit. Fong et al. now disperse a nano-optomechanical resonator in superfluid 4He, itself a mesoscopic quantum object, and show coupling in the low-excitation regime compatible with quantum measurements.

The researchers use a high-quality microdisk resonator and immerse it into ^{4}He. They record the quality factor and resonance frequency as a function of temperature when cooling down through the phase transition from standard to superfluid ^{4}He. Phonon coupling of the resonator to the superfluid dominates the dynamics of the coupled system, which is distinct from coupling to classical fluids, where viscous damping usually dominates. While earlier works investigated the coupling of nano- and micromechanical resonators to superfluid He already, the experiments were operated in different regimes. In the high MHz frequency regime explored in the work by Fong et al., the resonator transduces only 0.25 phonons per oscillation period to the superfluid at an exchange efficiency of >92%. This low-excitation level fulfils a major requirement for quantum operation in such a device. In future, the manipulation of superfluids in the quantum regime and at length scales below the superfluid coherence length seems possible. *BH*

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