METHODS IN BRIEF

NANOBIOTECHNOLOGY

Gene expression regulation using nanohorns

Optical control of gene expression has many potential applications, but the wavelengths of light required by existing methods are outside the effective optical window for biological tissue. Carbon-based nanoparticles are efficient photothermal energy converters with good absorption inside the optical window, but the metal catalysts used in their production present biocompatibility concerns. Synthesis of carbon nanohorns (CNHs), however, does not use metal catalysts. Miyako *et al.* show that bovine serum albumin (BSA)-coated CNHs are well-dispersed in solution and that the CNHs efficiently convert near-infrared (NIR) light—which falls inside the optical window—into heat, and with less cytotoxicity than other nanocarbon particles. Injection of suspensions of BSA-CNH and cells expressing a luciferase under a heat-shock promoter into mice, followed by NIR irradiation and imaging, showed a sevenfold increase in luminescence over non-irradiated controls and no evidence of toxicity.

Miyako, E. *et al. Proc. Natl. Acad. Sci. USA* **109**, 7523–7528 (2012).

NEUROSCIENCE

A window into the synapse

Visualizing the trafficking of synaptic proteins can help illuminate the functions of these critical neuronal components. However, a synapse's tiny dimensions and molecularly dense nature have made this endeavor difficult. Tanaka and Hirano tackled this problem by making cultured neurons synapse directly onto a coverslip and then monitoring the trafficking of fluorescently labeled receptors via total internal reflection fluorescence microscopy. The authors coated glass surfaces with the synaptic adhesion protein neurexin, which is known to induce postsynaptic differentiation in cells, and then plated rat hippocampal neurons onto them. The neurons bound to the neurexin molecules and formed postsynaptic-like structures. Tanaka and Hirano used this preparation to visualize the recruitment of fluorescently labeled glutamate receptors to the 'pseudo-synapses'.

Tanaka, H. & Hirano, T. *Cell Reports* **1**, 291–298 (2012).

SMALL RNAS

Joining forces to find microRNA targets

It is known that microRNAs, short, non-coding RNA transcripts, play an important role in regulating gene expression. What is still being debated is their mechanism of action and how to best identify their direct targets. In an effort to identify and validate microRNA targets, Jovanovic *et al.* combined RNA-binding protein immunoprecipitation (RIP), in which they affinity-purified mRNAs associated with the microRNA silencing complex, with selective reaction monitoring–mass spectrometry (SRM-MS) in *Caenorhabditis elegans* that expressed either wild-type or mutant microRNA of interest. SRM-MS allowed them to quantify the targets at the protein level. By comparing mRNA and protein abundance between wild-type and mutant worms, the researchers could distinguish between direct and indirect targets and differentiate between targets regulated at the level of translation or mRNA degradation.

Jovanovic, M. *et al. Genome Res.* advance online publication (19 April 2012).

SEQUENCING

Sequencing 5-hydroxymethylcytosine

Bisulfite sequencing is widely used to profile epigenetic DNA marks at single-base resolution, but it cannot distinguish between 5-methylcytosine (5-mC), a common repressive modification, and the oxidative product 5-hydroxymethylcytosine (5-hmC) because both are protected from bisulfite conversion to uracil. But 5-hmC may be an informative mark in its own right. Booth *et al.* report a way to oxidize 5-hmC to an intermediate form that is susceptible to bisulfite conversion. When a batch of DNA is split and subjected to both bisulfite and oxidative bisulfite sequencing, the positions and relative levels of both 5-mC and 5-hmC can be determined. Oxidation, which is specific to 5-hmC, converted 95% of residues in synthetic DNA with a low false-positive rate. The authors profiled 5-mC and 5-hmC at single-base resolution in mouse embryonic stem cells.

Booth, M.J. *et al. Science* advance online publication (26 April 2012).