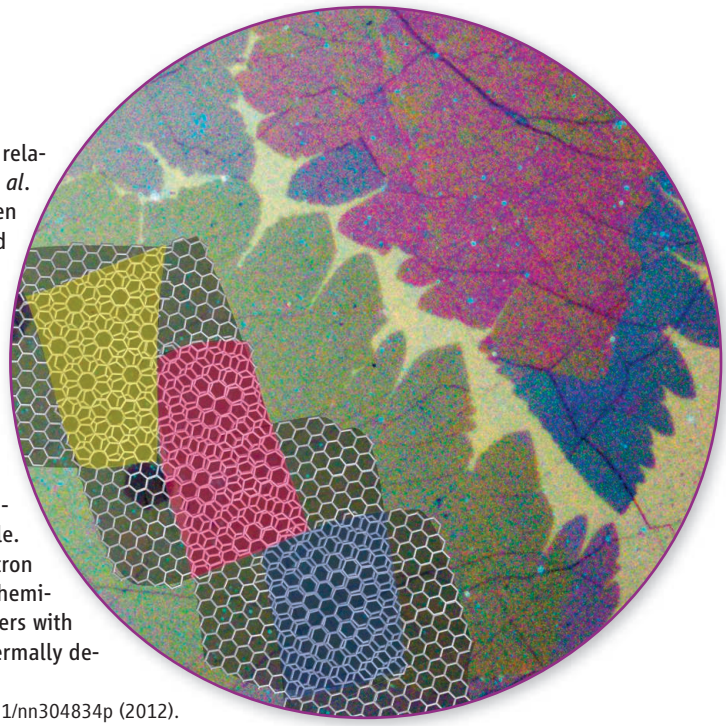
EDITED BY KRISTEN MUELLER AND MARIA CRUZ

MATERIALS SCIENCE

Graphene in Color



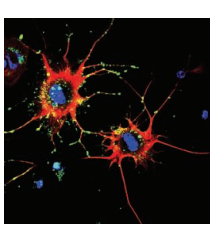
The properties of bilayer graphene films depend on the relative orientation or twist of the two layers. Robinson *et al*. grew single-layer graphene on copper surfaces and then performed two transfers of these films onto silica-coated silicon substrates to create bilayer regions. Because these films are polycrystalline, a variety of twist angles between the layers were created across the surface and resulted in a patchwork of colored regions that appeared red, yellow, or blue. Raman spectroscopy was used to characterize the twist angles; the enhancement of the G peak at ~1600 cm^{-1} occurred at optical excitation wavelengths that differed for the red and yellow regions, and the extent of enhancement corresponded to the deviation of the orientation of the layers from a distinctive critical twist angle. The twist angles were also confirmed by low-energy electron diffraction studies. The coupling could be minimized by chemical functionalization: fluorination of the top graphene layers with XeF_2 quenched the colors, which could be recovered by thermally desorbing the fluorine atoms. — PDS

ACS Nano 10.1021/nn304834p (2012).

DEVELOPMENT

A Positive Conversion

Tracing the pathways that lead to neuronal differentiation is important both for understanding neurodevelopment and because of the implications for developing therapeutics for degenerative diseases such as Parkinson's and Alzheimer's disease. Recent experiments have demonstrated that a group of transcription factors are capable of converting fibroblasts into neuronal cells in vitro and that the process involves microRNAs. To better understand the process, Xue *et al*. studied the role of a particular polypyrimidine-tract–binding protein (PTB) that is repressed during normal brain development by a microRNA, miR-124, and is known to be involved in the regulation of splicing of mRNA. Knockdown of PTB expression in HeLa cells, human embryonic carcinoma stem cells, mouse neural progenitor cells, and primary mouse embryonic fibroblasts induced a neuronal morphology and, for two of the cell types, expression of neuronal markers as well as synaptic activity. PTB not only acts as a target of miR-124, but also serves as a negative regulator of miRNA-124 and other microRNAS. An important consequence of PTB inhibition is the disassembly of the REST complex, which normally acts to silence neuronal genes in nonneuronal cells. Thus, the net result is to change a negative regulatory loop into a positive one and induce neuronal differentiation. — BJ



Cell 10.1016/j.cell.2012.11.045 (2013).

GEOLOGY

Flat Weathering

Weathering of silicate minerals is a primary sink for atmospheric CO_2. Much of the focus of recent research has been on the erosion of mountain belts, but as shown by Willenbring *et al.*, areas of lower relief may be more important in global budgets. These authors compiled measurements of denudation rates based on ^{10}Be concentrations in sediments. ^{10}Be is produced by the bombardment of near-surface minerals by cosmic rays; it builds up in stable landscapes and thus tracks both physical erosion and chemical weathering. The authors compared the denudation rates versus overall landscape slopes across nearly 1000 river basins globally and used these data to extrapolate to other areas. Overall, they calculate that about 5 gigatons of sediments are produced each year. Because most of Earth's surface has modest or lower slopes, even though the denudation rate there is relatively low (<10 mm per 1000 years), these areas contribute most of the sediment to the oceans. Thus, these areas, not mountains, may dominate the long-term drawdown of atmospheric CO_2. — BH

Geology 10.1130/G33918.1 (2013).

MATERIALS SCIENCE

Clicking Bones

A challenge in developing drug delivery vehicles or other tissue-specific biomaterials is to find ways to target them to the organs or tissues of interest. Heller *et al.* focused their study on modified dextran polymers, which can form porous nanoscale hydrogel particles. The dextran was initially modified with either alkyne or azide groups, which could then be clicked together within an inverse emulsion. The ratio of the two starting materials was biased to produce gels that had an excess of either alkyne or azide groups to allow for further functionalization of the gels. When injected into mice, unmodified dextran gels primarily accumulated in the liver as well as the lymph nodes, spine, and femur. Further, gels that entered the bone marrow were engulfed by F4/80+ cells. Bisphosphonates have been used to treat osteoporosis and have been coupled to polymers that have shown bone-tissue localization; thus, this group was added via a second click reaction to gels showing excess alkyne groups. Once modified via a second click reaction to show bisphosphonates groups, the nanogel particles showed significantly less uptake by the liver and reduced uptake by the F4/80+ cells. The particles also showed binding to both cortical and trabecular bone lining the marrow cavities. Perhaps more interesting was the overall reduction in F4/80+ cells within the bone marrow, suggesting that they might also provide an anti-osteoporotic effect. — MSL

Adv. Mater. 10.1002/adma201202881 (2012).

Published by AAAS

CELL BIOLOGY

Rab-ing Up ER Dynamics

The endoplasmic reticulum (ER) forms a lace-like network throughout the cytoplasm and exhibits a remarkable ability to remodel itself constantly. How the membranes of the ER can grow, fuse, and divide faithfully and efficiently within cells is not altogether clear, although several factors involved in the regulation of ER dynamics have been identified. Intracellular membrane fusion frequently involves members of the Rab GTPase family. English and Voeltz wanted to determine which Rab was involved in ER dynamics. ER vesicles were isolated from *Xenopus* egg extracts and shown to be able to form tubular ER networks in vitro. Although several Rab GTPases were associated with these vesicles, only Rab10 localized to ER-associated structures that could move along microtubules and that appeared to be associated with new ER tubules in mammalian tissue culture cells. Reducing the levels of Rab10 or the expression of a Rab10 mutant reduced the number of ER tubules, because of an impaired ability of dynamic ER tubules to grow from and fuse with other ER membranes. Intriguingly, the Rab10 ER tip structures were also associated with a pair of proteins involved in phospholipid synthesis. — SMH

Nat. Cell Biol. 10.1038/ncb.2647 (2012).

ENVIRONMENTAL SCIENCE

Don't Throw It in the Bin!

Compact fluorescent lamp (CFL) and light-emitting diode (LED) bulbs use between 70 and 85% less energy than traditional incandescent bulbs and have vastly longer lifetimes, providing the potential for substantial energy savings. However, they are much more complex in design than traditional bulbs, with potential adverse environmental impacts similar to those of consumer electronic devices. Lim *et al.* have assessed the environmental and resource depletion impacts from metals in all three types of bulbs, focusing on the bulbs' end of life. The metal content of CFL and LED bulbs was much higher than that of incandescent bulbs, exceeding California's regulatory limits for lead, copper, and zinc in the case of CFL bulbs and for copper and lead in the case of LED bulbs; both types of bulbs would be classified as hazardous waste under U.S. federal and California state regulations. Furthermore, the availability of several metals contained in the bulbs is highly limited. There is thus an urgent need for appropriate waste management, as well as technological development to reduce the content of toxic or rare metals in the bulbs and/or extend bulb lifetimes. — JFU

Environ. Sci. Tech. 10.1021/es302886m (2012).

CREDIT: OLADELE OGUNSEITAN

IMMUNOLOGY

HIV Under Pressure

The RV144 HIV-1 vaccine trial was the first clinically validated preventative vaccine to show efficacy against HIV infection. Since the release of these results, there has been great interest in understanding how protection occurred. Protection correlated with antibodies against the V1 and V2 regions of the gp120 envelope protein of HIV-1. In addition, increased efficacy was seen against virus strains that matched the vaccine strain at V2 residue 169. Liao *et al*. isolated four antibodies from RV144 vaccines that were specific for V2 and residue 169. These antibodies were able to neutralize several lab strains of HIV-1 and could kill $CD4^+$ T cells that were infected with field-isolated strains of the virus. Structural analysis of two of the antibodies, along with a previously described broadly neutralizing antibody that recognizes V2, demonstrated that although the antibodies recognized similar residues of V2, these residues were in very different conformations. Such structural variation suggests that this may be a site of viral vulnerability and implies that the vaccine may have induced immune pressure in this region. — KLM

Immunity 10.1016/j.immuni.2012.11.011 (2013).

Rab-ing Up ER Dynamics

Stella M. Hurtley

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