CHEMISTRY

Cool Clustering

The decomposition of a precursor within a polymeric medium can yield metal nanoclusters with narrow size distribution and uniform morphology. Gazit et al. explored the impact of this approach, performing the synthesis below the glass transition temperature ($T_g$) of the polymer, thereby precluding large-scale motions of the polymer segments. For iron nanoparticles within a polystyrene (PS) matrix, a large reduction in temperature shifted size and morphology from 70-nm spherical particles to 50-by-3-nm needles, whereas intermediate temperatures produced 8-nm spheres. Formation rates scaled exponentially with temperature above and below $T_g$. In the case of a poly(methyl methacrylate) (PMMA) matrix, similar size and morphology changes occurred, but the rate of cluster growth below $T_g$ proved insensitive to temperature. The authors attribute the discrepancy to the relatively strong coordinative bonding between cluster and polymer present in the PMMA matrix but absent from PS. Taken together, the results support tuning of polymer segment mobility as an additional control variable in the synthesis of metal clusters. — MSL


PLANT BIOLOGY

Leaf Production Plant

Leaf epidermis, usually a single layer of cells, negotiates the balance between environmental factors and internal physiology. Leaf epidermal cells synthesize a wax that serves as a protective surface barrier and also synthesize a variety of complex metabolites important in plant defense. Leaves of the Madagascar periwinkle (Catharanthus roseus), long known as an herbal medicine, synthesize the alkaloids vinblastine and vincristine, which have valuable anticancer activities. In the search for other useful alkaloids or metabolites, Murata et al. have exploited RNA analysis of the leaf epidermis. C. roseus epidermis is rich in a variety of biosynthetic pathways, including those for flavonoids, lipids, and pentacyclic triterpenes. Analysis of RNAs expressed in leaf epidermis revealed much more complexity of the biochemistry occurring in leaves than did similar analytic approaches using broader tissue samples of the plant. The diversity of biosynthetic pathways represented in the leaf epidermis, combined with the variable destinations of the products, makes this single layer of cells look like the busiest of production and distribution centers. — PJH


NEUROSCIENCE

More to Noradrenaline

Noradrenaline is a well-established neuromodulator in many parts of the brain. Its effects have usually been described in terms of its impact on cells or synapses. Using paired recordings from connected GABAergic interneurons in the hippocampus, Zsíros and Maccaferri investigated a novel type of noradrenergic modulation. Activation of β-adrenergic receptors decreased gap junction–dependent electrical coupling between inhibitory interneurons. A series of pharmacological interventions established that this effect was due to activation of the cAMP/protein kinase A signaling cascade. Electrical coupling is important for the coordination of interneuron activity, which may lead to synchronous firing and oscil-
lations of larger neuronal networks. Noradrenergic modulation of electrical coupling between connected inhibitory interneurons can thus have important effects on information transmission in the whole GABAergic inhibitory hippocampal network and hence on signal propagation throughout the hippocampus and the many other brain regions connected to it. — PRS

**ECOLOGY**

**Shared Prosperity**

The relationships between biodiversity and ecosystem function (such as productivity and nutrient dynamics) have mostly been investigated with tractable ecological communities such as herbaceous vegetation. Now Potvin and Gotelli have extended such studies to simple tree communities, with an experiment on the effects of tree species diversity on yield, measured by growth in tree basal area.

In a forest plantation in Panama, plots in which several species of tree seedlings were planted yielded 30 to 58% more growth than monocultures after 5 years. The increased yield resulted from increased growth in the mixed-species plots rather than from mortality in the monocultures. The authors speculate that competition for light is greater in monocultures, implying that more effective partitioning of resources permits more biomass accumulation in the mixed-species plots. — AMS


**CHEMISTRY**

**Crystals of an Iron Nitride**

Both industrial and enzymatic nitrogen reduction catalysts rely on iron centers. However, high valent molecular iron nitride complexes (Fe=–N) have stubbornly eluded crystallographic characterization, in contrast to analogous terminal oxo structures (Fe=–O). Vogel et al. now find that a tridentate ligand comprising three coordinating N-heterocyclic carbene moieties offers the solution. Reaction of the ligand (bearing either xylyl or mesityl groups for steric protection) with ferrous chloride followed by reduction with sodium amalgam and treatment with trimethylsilylazide yields a cationic Fe-N$_3^+$ complex that loses dinitrogen under xenon lamp photolysis to afford the terminal iron nitride. Air-stable purple crystals of the compound were characterized by x-ray diffraction, revealing a short FeN bond length of 1.53 Å. Mössbauer spectroscopy further suggested an iron center more electron-rich than a previously prepared phosphorus-coordinated iron nitride characterized in solution; the authors attribute the difference to π-donation from the carbene ligands. — JSY


**<< Pulling on the TCR**

The exact mechanism by which peptide-loaded major histocompatibility complex (pMHC) activates the T cell receptor (TCR) has been controversial. Effective TCR activation requires presentation by antigen-presenting cells—soluble pMHC cannot activate T cells. In the presence of endogenous pMHC, however, very low concentrations of agonist pMHC are required to activate TCR signaling, as are costimulatory interactions. Ma et al. anchored pMHCs to lipid bilayers or plastic surfaces and found that in the absence of nonagonist pMHC, a minimum of 1 to 10 monomeric agonist pMHCs (MCC-loaded pMHC) per T cell was sufficient to stimulate TCR signaling in T cells interacting with the artificial substrates. Furthermore, the T cell response (calcium signal) was not enhanced by the addition of nonagonist pMHC with the agonist pMHC or under conditions where the nonagonist pMHC and agonist pMHC were close enough to function as a dimer. When murine B cell lymphoma cells were loaded with various endogenous peptides and the MCC peptide, the production of interleukin-2 by the T cells was the same whether a costimulatory endogenous pMHC was present or not. In further experiments, adhesion was shown to be necessary for TCR triggering, as was the actin cytoskeleton.

The authors propose a model whereby the agonist pMHC-TCR interaction leads to receptor deformation and activation when the cytoskeleton provides a pulling force on the complex. Endogenous pMHC-TCR interactions would be insufficiently strong to provide the necessary activation signal, and the complex would dissociate when "pulled on" by the cytoskeleton. — NRG