

Angiogenesis (green) in periostin-treated hearts.

BIOMEDICINE

Recovering from a Heart Attack

The extracellular matrix (ECM) is increasingly being recognized as a dynamic network of molecules that participates actively in the cellular signaling events that determine an organ's state of health. Most forms of heart failure, for example, are accompanied by alterations in the composition of the ECM. Myocardial infarction (MI) leads to a dramatic increase in the expression of periostin, a 90-kD protein secreted by fibroblasts, yet whether periostin promotes repair of heart damage or contributes to it has been unclear. The answer may be both, as indicated by two research groups who have independently explored periostin function using distinct model systems. In a cell culture study, Kühn *et al.* found that the addition of recombinant periostin to differentiated rat cardiomyocytes caused them to reenter the cell cycle and divide, a process that required integrins as well as phosphatidylinositol 3-kinase. Sustained delivery of recombinant periostin to the heart of rats after experimental MI reduced the extent of heart damage and improved heart function, leading the authors to conclude that the protein enhances heart repair. Oka *et al.* studied mice genetically deficient in periostin. Intriguingly, the mutant mice showed improved cardiac function after MI over the long term, a result the authors attribute to the protein's role in regulating cardiac remodeling and hypertrophy. — PAK

Nat. Med. **13**, 10.1038/nm1619 (2007); *Circ. Res.* 10.1161/CIRCRESAHA.107.149047 (2007).

CHEMISTRY

A Light for the Cure

Zeolites are mesoporous minerals used as ion-exchange beds in water purification and softening, and as chemical reaction platforms. Pure silica zeolites have been grown as polycrystalline films on nonporous supports, but the potential utility of these materials depends on their hydrophobicity and porosity, which in turn depends on the presence of grain boundaries. Post-deposition treatments have been used to remove the hydrophilic silanols that form, but typically these approaches either fail to penetrate the pore structure or fail to stand up to the heating required to remove the organic template used during zeolite growth.

Eslava *et al.* show that strong ultraviolet (UV) irradiation during the heating process induces hydrophobicity while also improving the pore structure by creating smaller pores with a narrower distribution. They deposited suspensions of the zeolite silicalite-1 that had been mixed with tetrapropylammonium (TPA) as the organic templating material. UV irradiation during calcination induced methylation by TPA fragments, as well as condensation of polar silanol groups.

Film cracking and delamination effects common in other nanocrystalline systems were also suppressed. — MSL

J. Am. Chem. Soc. **129**, 10.1021/ja0723737 (2007).

GEOLOGY

Early Earth Mirrored in Zircon

The oldest minerals on Earth—a few dating as much as 4.4 billion years ago—are igneous zircons that have been eroded and incorporated into comparatively younger 3.8-billion-year-old sedimentary rocks.

Several studies have examined the geochemistry of these zircons and inferred conditions on early Earth and the composition of its early crust. Initial results based

Zircons imaged by cathodoluminescence.

on the zircon oxygen isotopic compositions and trace element chemistry have implied that liquid water was abundant and that some magmas were cool and water-rich.

Two related studies provide expanded data and additional constraints. Harrison *et al.* examined the titanium content of zircons, which can be

related to the crystallization temperature and thus the water and silica content of a magma. Through a comparative study of zircons in younger granites, they argue that the overall distribution of data in the very old zircons is most consistent with derivation from magmas that formed by remelting of water-rich crust. Trail *et al.* examined the oxygen isotope compositions and confirmed that several grains have high $^{18}\text{O}/^{16}\text{O}$ ratios, implying derivation of the host magma from water-altered crust or sediments. Together the data imply that early Earth had a vigorous rock cycle involving water, erosion, and burial and heating of sediments, like that operating today. — BH

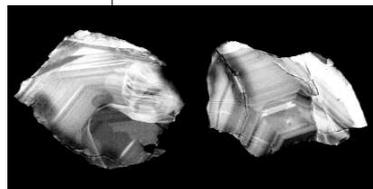
Geology **35**, 635 (2007); *Geochem. Geophys. Geosyst.* **8**, 10.1029/2006GC001449 (2007).

MOLECULAR BIOLOGY

Promoting Silence

RNA interference (RNAi) can modulate gene expression at the posttranscriptional stage by prompting the degradation of mRNA or blocking its translation into protein. The mRNA is targeted by homologous ~22-nt short interfering (si) RNAs. RNAi can also inhibit gene transcription itself, promoting the formation of silent heterochromatin in yeast, and evidence indicates that siRNAs act via the degradation of low-abundance

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nascent transcripts, rather than on the DNA. In human cells, siRNAs directed against promoter sequences can block gene transcription. Do these siRNAs act on the promoter DNA or, as in yeast, an RNA species? Han *et al.* analyze transcripts from the human EF1a promoter and find a low-abundance sense RNA that initiates ~230 bp upstream of the previously characterized promoter and appears to be a variant EF1a mRNA. Suppression of this variant reduces the ability of promoter-targeted siRNAs to induce transcriptional silencing and to enhance the formation of associated silent chromatin marks. Related results are seen for several other gene promoters in human cells, leading the authors to speculate that these promoter RNAs might function similarly in vivo. — GR

Proc. Natl. Acad. Sci. U.S.A. **104**, 10.1073/pnas.0701635104 (2007).

PHYSICS

Cooler Vibrations

Optical back action can be used to cool micrometer-sized objects such as microresonators and micromirrors to temperatures as low as 1 K. The motivation for such cooling is to be able to access the quantum mechanical oscillations of the thermal vibrations and to use the measurement of these ultrasmall vibrations as exquisite motion sensors for detecting gravity waves as well as for probing possible quantum-mechanical effects in macroscopic systems. Poggio *et al.* show that the cooling can be taken a step further by optimized coupling of an optical cooling setup with the electromechanical motion of a single-crystal silicon cantilever. In their system, 100 nW of laser light is focused onto the paddle of the mass-loaded cantilever, the motion of which is detected in an arm of an interferometer. This interferometric signal is then fed back to induce a piezoelectric mechanical response, resulting in cold damping of the cantilever motion. The net effect is a lowering of the cantilever temperature below 5 mK. — ISO

Phys. Rev. Lett. **99**, 017201 (2007).

BIOCHEMISTRY

A Case of Iron Poisoning

In order to carry out redox reactions on small diatomic gases (such as H₂ and N₂), enzymes enlist the help of metal atoms, often grouping them into clusters and decorating them with non-protein ligands. The [NiFe] hydrogenase offers a case in point; within the Ni-Fe cluster at the active site, the iron atom binds two molecules of cyanide and one of carbon monoxide. Previously,

the hydrogenase maturation protein HypF has been shown to transfer a carbamoyl group to a cysteine residue of HypE, which then dehydrates it in situ to generate a thiocyanate (enzyme-SCN).

Watanabe *et al.* have solved the crystal structures of the proteins HypC, HypD, and HypE, which together append the two cyanide moieties to the iron atom—subsequently, a CO is added and the Fe(CN)₂(CO) subassembly is cemented into the large subunit of the hydrogenase before the Ni atom is inserted. They propose that upon binding of HypE to a HypC-HypD complex, a series of thiol-disulfide exchanges occurs.

These reactions transfer the CN group from the cysteine of HypE onto the iron atom, which is jointly coordinated by cysteine and histidine residues contributed by HypC and HypD; repeating these steps with a second charged HypE serves to add the second CN ligand. HypD contains its own [4Fe-4S] cluster, which acts catalytically, rather than constitutionally, in facilitating the cysteine redox cascade. — GJC

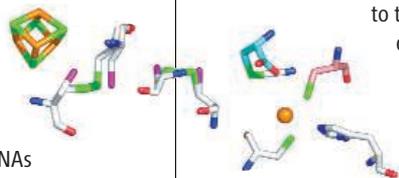
Mol. Cell **27**, 29 (2007).

CHEMISTRY

Saddling Up Porphyrins

The stereochemical purity of a polymer or supramolecular assembly can often be set by a comparatively small chiral enrichment of the molecular building blocks or their coordination partners in solution. Toyofuku *et al.* have harnessed this effect to amplify the chiral enrichment of an ensemble of porphyrin complexes. They had previously shown that on complexation with chiral acids, the interconverting saddle-shaped enantiomers of an aryl-substituted porphyrin locked into one favorable diastereomeric conformation, which was conserved when the chiral acids were displaced by the achiral coordinating partner acetic acid. When they instead formed coordination polymers by linking the porphyrins through complexation of tethered pyridyl substituents to Pt ions, they found that the addition of a chiral acid during assembly had a nonlinear amplification effect on the stereochemical outcome. An acid sample of 40% enantiomeric excess was sufficient to induce the highest observed optical purity of the assembly. By adding excess acetic acid and a phosphine ligand, they could then disassemble the polymer and obtain a fully enriched sample of the porphyrin-acetic acid saddles. — JSY

Angew. Chem. Int. Ed. **46**, 10.1002/anie.200701668 (2007).



A cysteine relay system (green) adds the first CN (light blue) to the Fe (yellow sphere).