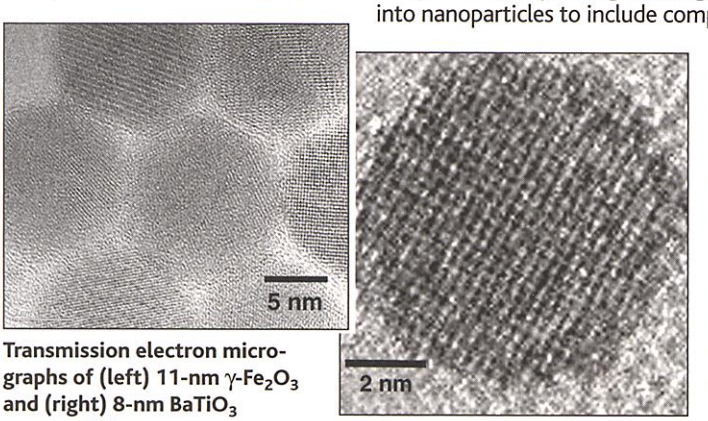
EDITORS' CHOICE

edited by Gilbert Chin

CHEMISTRY

Monodisperse Metal Oxide Nanoparticles

The practicality of using nanoparticles in technological applications will depend in part on avoiding costly and time-consuming separation steps and on expanding the range of materials that can be made into nanoparticles to include complex oxides. Hyeon *et al.* synthesized highly crystalline, monodisperse nanoparticles of maghemite (γ-Fe_2O_3) through the high-temperature aging (300°C) of an iron–oleic acid complex. The particles, whose size could be varied from 4 to 16 nanometers (nm), may find a use in magnetic recording or in ferrofluids. O'Brien *et al.* synthesized monodisperse nanoparticles of ferroelectric barium titanate ($BaTiO_3$). Particle sizes ranged from 4 to 12 nm, depending on conditions in their sol-gel route. Such particles not only could be used in devices but also could help resolve fundamental mechanistic questions concerning the suppression of ferroelectricity (spontaneous polarizability) in nanoparticles. — PDS



Transmission electron micrographs of (left) 11-nm γ-Fe_2O_3 and (right) 8-nm $BaTiO_3$ nanoparticles.

J. Am. Chem. Soc. 10.1021/ja016812s; *J. Am. Chem. Soc.* **123**, 12085 (2001).

CLIMATOLOGY

Really Deep Breathing

Deep-sea mixing (ventilation) rates depend on how fast deep sea water is formed. The deep sea contains more than 95% of the carbon in the ocean-atmosphere system, so the ventilation rate directly affects atmospheric composition and radiative forcing. Goldstein *et al.* present a suite of radiocarbon and uranium-series dates of deep-sea corals from the Southern Ocean and derived rates of deep-sea ventilation for the present and the last glacial period (about 16,500 years ago). They calculate that the ventilation age then was 20 to 40% greater than at present. This result is consistent with reported findings from the Atlantic and Pacific Oceans and suggests that glacial oceans mixed more slowly than today's oceans. Thus, glacial-age, carbon-rich deep water may have mixed less quickly with surface water and exchanged CO_2 less rapidly with the atmosphere. Slower mixing would have significantly lowered the partial pressure of atmospheric CO_2 during that period. — HJS

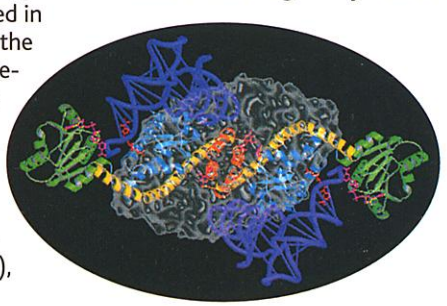
Earth Planet. Sci. Lett. **193**, 167 (2001).

BIOCHEMISTRY

Through Proper Channels

Tetrapyrroles are essential building blocks for respiration (hemes) and photosynthesis (chlorophylls). In plants and most prokaryotes, glutamyl-tRNA, besides being used in protein biosynthesis, is the starting point for synthesis of tetrapyrroles. The activated glutamate is reduced to glutamate-1-semialdehyde by the NADPH-dependent enzyme glutamyl-tRNA reductase (GluTR), and the semialdehyde then undergoes transamination by glutamate-1-semialdehyde aminomutase (GSAM), yielding the tetrapyrrole precursor 5-aminolevulinic acid.

Moser *et al.* describe the V-shaped structure of dimeric GluTR in complex with a substrate-like inhibitor and find that it supports the proposed mechanism of catalysis via a thioester intermediate. Reduction of the thioester to the semialdehyde would require movement of the distal NADPH-binding domain, and modeling the GluTR structure with a substrate glutamyl-tRNA reveals a shallow surface that could accommodate just such a tilted domain, which would bring the NADPH close to the glutamate-binding pocket. The reactive semialdehyde intermediate serves as a metabolic link between the enzymes GluTR and GSAM. The latter also forms a dimer, and that dimer can be modeled snugly into the cleft of the "V". Strikingly, this complex reveals a conduit between the peripheral glutamate binding pocket in GluTR and the central active site in GSAM, enabling transfer of the semialdehyde without exposure to the aqueous environment. — VV



Model of GluTR (green, cyan, orange), GSAM (gray surface), and glutamyl-tRNA (dark blue), showing the channeled semialdehyde (red).

EMBO J. **23**, 6583 (2001).

MICROBIOLOGY

Promoting Prion Propagation

The prion diseases, including transmissible spongiform encephalopathies, result from the aberrant folding and aggregation of proteins. The deleterious consequences of producing protease-resistant complexes of prions cannot be overstated.

One approach to understanding the precise mechanisms of pathological prion formation and propagation involves the study of prion-based phenotypes in yeast. Borchsenius *et al.* examined the propagation of the [*PSI*$^+$] prion phenotype, which involves the aberrant folding and aggregation of the Sup35 protein. Deleting a portion of *Sup35* generated a protein that was defective in propagating itself because it could not efficiently produce "seeds" of aggregated Sup35 to pass on to new generations of yeast. The defect could be corrected by the overproduction of chaperone Hsp104, which disaggregated Sup35.

Priola and Lawson examined the importance of posttranslational modification for prion

CONTINUED ON PAGE 2253

propagation. In culture, mammalian prion protein can be released from cells, and different species produce prion proteins that are distinctive in amino acid sequence and in glycosylation patterns. When examining the ability of secreted prion protein to form aggregates with prions from different species, they discovered that glycosylation could affect the binding of soluble, protease-sensitive prion protein to insoluble, protease-resistant prion protein. These findings may help to explain aspects of the barriers to transmission of prion diseases between a variety of host species. — SMH

EMBO J. **20**, 6683; 6692 (2001).

BIOMEDICINE

Disabled Editing in Tumors

As tumor cells progress to a more malignant state, they accumulate a number of genetic alterations, including some that can disrupt the fundamental mechanisms regulating gene expression. One of the posttranscriptional regulatory mechanisms that might be vulnerable in tumor cells is RNA editing, an enzyme-mediated process in which newly synthesized messenger RNAs (mRNAs) undergo selective base modifications that can dramatically alter the function of the encoded protein.

Studying RNA editing patterns in human glioblastoma multiforme (GBM), a highly malignant form of brain tumor, Maas *et al.* discovered that the mRNA encoding the glutamate receptor subunit B was severely underedited at a nucleotide position that must be changed from adenosine to inosine for normal receptor function. Intriguingly, underediting at this position has been linked previously to epileptic seizures, a complication that often is seen in patients with GBM. Consistent with the loss of A → I RNA editing, the tumors showed reduced activity of adenosine deaminase 2 (ADAR2), the enzyme responsible for this modification.

Other tumor-associated alterations in RNA editing are described in a separate study by Mukhopadhyay *et al.*, who found evidence of aberrant C → U editing of neurofibromin mRNA in about 25% of peripheral nerve-sheath tumors from patients with neurofibromatosis type I. The same subset of tumors also showed enhanced expression of the RNA editing enzyme catalyzing this modification, apobec-1. The functional role that deregulated RNA editing plays in tumorigenesis is an important issue that remains to be explored. — PAK

Proc. Natl. Acad. Sci. U.S.A., **98**, 14687 (2001); *Am. J. Hum. Genet.*, in press.

NEUROSCIENCE

Active Brains Before Birth

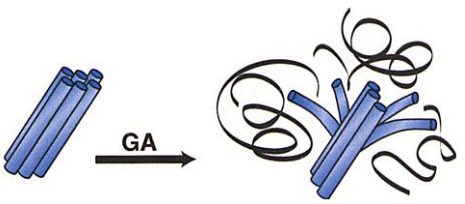
The functional development of primate cortical structures is practically undocumented. Much of our understanding comes from experiments on rodents and from descriptive morphology. Khazipov *et al.* have investigated the ontogeny of hippocampal neurons and circuits in the fetal primate brain by recording from pyramidal cells and interneurons in hippocampal slices, followed by morphological analysis. At midgestation, previously silent neurons began to acquire first GABAergic and then glutamatergic synaptic inputs. Concomitantly, apical dendrites developed, and then dendritic spines appeared. Thus, a complex network that can generate spontaneous and paroxysmal synchronized activity was established before birth. Several aspects that appear postnatally in rodents are shifted toward fetal life in the primate, suggesting that these processes may be largely independent of external stimuli and may follow predetermined developmental rules. — PRS

J. Neurosci., in press.

CHEMISTRY

Nonadhesive Gum Arabic

Carbon nanotubes (NTs) are often synthesized as ropes or bundles of highly aligned tubes, but many applications require individual NTs. Separation methods that coat the NTs with organic solvents or polymers can alter the electronic properties of the NTs, and sonication with a surfactant can cut and damage the NTs.



Schematic of gum arabic adsorption onto the ends of nanotubes.

Drawing on an ancient Egyptian recipe for making carbon-black ink, Bandyopadhyaya *et al.* used gum arabic (GA), a highly branched arabinogalactan polysaccharide, to dissolve individual NTs in aqueous solution. The authors argue that gum arabic physically adsorbs onto the NT surfaces and causes the NTs to exfoliate. Once in solution, the adsorbed polymer chains repel each other, thus disrupting the interactions between tubes and stabilizing the isolated NTs. — MSL

Nano Lett., 10.1021/nl010065f.

SOURCE: BANDYOPADHYAYA *ET AL., NANO LETT.*, 10.1021/NL010065F