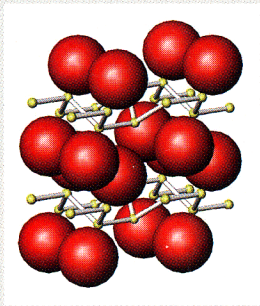
CONCENTRATES

Osmium diboride: Hard by design

Valence electron density and bond covalency can serve as design parameters for preparing novel incompressible materials, a new study shows (*J. Am. Chem. Soc.* **2005,** *127,* 7264). Incompressible, hard materials are widely used to provide durable and wear-resistant coatings for drilling and cutting tools and in other applications. Sarah H. Tolbert, Richard B. Kaner, and their coworkers at the University of California, Los Angeles, note that incompressibility (or bulk modulus) and valence electron density are correlated in many materials. Likewise, bulk modulus and hardness are often correlated, as is the case for diamond, the hardest known substance. Osmium's valence electron density and bulk modulus are close to the values for diamond. Diamond is much harder than metallic osmium, the team explains, because of diamond's highly covalent and directional bonds. To introduce covalent bonding and thereby increase osmium's hardness, the team developed solid-state synthesis procedures for preparing OsB_2 (shown, red = Os; yellow = B). Qualitative scratch tests indicate that OsB_2 is indeed hard and that it has a bulk modulus between 365 and 395 GPa (diamond = 442 GPa).

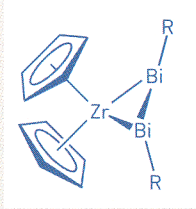


Earlier ovarian cancer detection

Because early stages of ovarian cancer elicit few symptoms, the disease often goes undetected until it is relatively advanced. Furthermore, doctors lack a sensitive screening method for ovarian cancer. Gil Mor of Yale University, David C. Ward of the Nevada Cancer Institute, and colleagues have designed a new blood test that may provide a woman with earlier notice of the disease (*Proc. Natl. Acad. Sci. USA* **2005,** *102,* 7677). The researchers first quantified 169 proteins in serum from healthy women and women with cancer. On the basis of their results, they designed a test that measures four proteins whose levels differed significantly in the two groups: leptin, prolactin, osteopontin, and insulin-like growth factor II. If the test indicates that a woman's levels of at least two of the four proteins are outside the norm, she likely has cancer. The assay shows 95% sensitivity and 95% specificity, meaning that in 95% of tests, it correctly identifies those with cancer and those who are cancer-free, respectively.

Zr complex has RBi=BiR ligand

A compound (shown) in which a dibismuthene (a molecule with a bismuth-bismuth double bond) is complexed to a zirconocene has been prepared for the first time at the University of Georgia, Athens (*J. Am. Chem. Soc.* **2005,** *127,* 7672). It is the first organometallic compound containing Bi–Zr bonds and the only example of a $ZrBi_2$ ring, according to the team led by chemistry professor Gregory H. Robinson. They prepared the complex by sodium metal reduction of $(\eta^5\text{-}C_5H_5)_2ZrCl_2$ with $RBiCl_2$, where R is the bulky 2,6-dimesitylphenyl group. Since RBi=BiR with the identical R substituent can be prepared by itself, it's now possible to study this dibismuthene in both its uncomplexed and complexed forms, Robinson notes. The complexed ligand, for example, has an appreciably longer Bi–Bi bond. Although acyclic bonding models are conceivable for the metallocene-complexed dibismuthene, the researchers, in collaboration with theorist Paul v. R. Schleyer's group, conclude that the molecule is best depicted as a metallocycle.



Ultrafast electron microscopy

By integrating fast laser methods with transmission electron microscopy (TEM), researchers at Caltech have developed a microscopy technique that combines Angstrom spatial resolution with femtosecond time resolution (*Proc. Natl. Acad. Sci. USA* **2005,** *102,* 7069). The procedure, which was developed by Ahmed H. Zewail, Vladimir A. Lobastov, and Ramesh Srinivasan, has been used to image various types of samples including gold crystals, amorphous carbon, and cells from rat intestines. Unlike conventional TEM, in which a hot cathode supplies electrons continuously via thermionic emission, in the Caltech method, electron emission is caused by illuminating the cathode with weak femtosecond laser pulses. Because it liberates very few electrons per pulse, the procedure sidesteps some of the difficulties that tend to broaden the electron beam and limit resolution. It also enables TEM images and videos to be recorded with unprecedented time resolution, thereby providing a route to atomic-scale dynamics studies of complex systems.

Ocean's organic nitrogen charted

Amide-containing biopolymers that help control the ocean's nitrogen budget—and, consequently, its denizens' ability to sequester atmospheric CO_2—have been chemically characterized (*Science* **2005,** *308,* 1007). These and other nitrogen-containing biopolymers (known as dissolved organic nitrogen or DON) are abundant in many parts of the ocean, even where the availability of inorganic nitrogen limits the productivity of marine organisms. A team led by Lihini I. Aluwihare of Scripps Institution of Oceanography collected high-molecular-weight DON (HMWDON) from both the surface and the deep ocean. They then subjected the samples' amide linkages to mild acid hydrolysis to differentiate proteins (bottom) from N-acetyl amino polysaccharides such as chitin (top). Such treatment yields amino acids in the case of proteins, and acetic acid in the case of chitin and related polymers. They find that N-acetyl amino polysaccharides account for half of the surface HMWDON. The remaining surface HMWDON and nearly all deep-sea DON, however, resist both chemical hydrolysis and biological degradation.