Sunny Chemistry Outlook Revealed in Hawaii

For 7000 chemists from 21 chemical societies, Oahu was the gathering place this past December. At the Second International Congress of Pacific Basin Societies (sponsored by the Chemical Society of Japan, the Canadian Institute of Chemistry, and the American Chemical Society), it was clear that the process of discovery in chemistry is being driven not only by investigation of new phenomena but also by efforts to solve specific practical problems in areas ranging from medicine to materials science.

Mountain in the Sea

The mountain isn't Mauna Loa but a "mountain" of relatively stable elements nuclear chemists have predicted should exist near element 114. Getting to the mountain has proved difficult, because it lies beyond a "sea" of unstable elements that decay rapidly (on femtosecond scales) by spontaneous fission. Navigational guidance—in the form of theory about how to create the elements near 114—is needed. Much of the theoretical problem centers on the balance of neutrons and protons necessary for stability. Ken Hulet of Lawrence Livermore National Laboratory (LLNL) is cautiously optimistic that a sea route will soon be found. According to Hulet, new information is being gathered as heavy isotopes and elements with longer decay lifetimes are found. Results from LLNL show that neutron-rich isotopes of elements such as nobelium (element 102) have comparatively long fission lifetimes. In addition, the heaviest known elements—108 and 109—discovered at the Gesellschaft für Schwerionenforschung in West Germany, decay by alpha-particle emission and have much longer (millisecond) lifetimes. Such results have forced revisions in the theory of how neutrons keep the nucleus together—revisions that are helping map a course to the mountain.

Reaching for the Ring

Paul Wender of Stanford University and his research group have hit on a new method of synthesizing phorbol—a discovery that may be of much more than academic interest. The reason? Many phorbol esters are tumor promoters: although not themselves carcinogens, they amplify the effects of certain carcinogenic substances. Understanding tumor promotion would be greatly aided by a supply of phorbol derivatives, but until now there was no synthetic route. The problem lay in phorbol's structure, which includes a five-membered ring joined to a seven-membered ring. Although many ring-building methods rely on subunits with an even number of carbon atoms, Wender's method is an odd-numbered, "5 + 2" addition that has the advantage of leaving the seven-membered ring bridged by an ether linkage, which minimizes ring twisting and increases control over subsequent synthetic steps. Wender and his colleagues have used the method to make phorbol with a 93% yield for the active biological form.

Getting the Blues

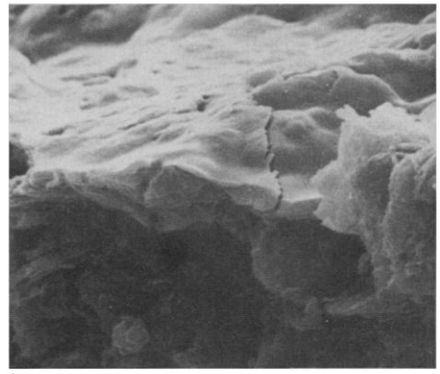
The laser diode is an inexpensive source of infrared radiation. Many laser applications, however, such as high-density optical disk memories, require the higher frequency of visible light. Enter Hidetaka Ninomiya, Miki Morita, and Kazuo Asano of Konica Corporation. They have developed an organic crystal that can double the frequency of infrared radiation, yielding blue-green light. The process, known as second-harmonic generation, requires crystals of molecules with a high nonlinear polarizability. The Konica investigators studied a number of phenol derivatives and settled on 2-methoxy-5-nitrophenol. Fibers of this compound converted the output of an Nd-YAG (neodymium-yttrium-aluminum-garnet) laser to blue light. Next on the agenda: testing with a laser diode source.

CO_2 in Space

At a symposium honoring a deceased colleague, Louis d'Hendecourt of the University of Paris and M. Jourdain de Muizon of Leiden University reported the first solid evidence for carbon dioxide (CO_2) in space. Although it has been suggested that CO_2 exists in space, the molecule is invisible to radio telescopes, and its abundance in the earth's atmosphere precludes ground-based optical studies. The European workers searched the IRAS satellite Low Resolution Spectra database and discovered three sources in the Rosette and Cone Nebuli that yielded the 15.2-micrometer bending mode characteristic of CO_2 embedded in ice; the ice probably coats interstellar dust grains. D'Hendecourt and Jourdain conclude that CO_2 is as abundant as carbon monoxide (CO) (one of the most abundant interstellar molecules) on the grains, and they argue that CO_2 is formed there from CO by ultraviolet light. Their findings were discussed at a symposium honoring Hiroko Suzuki of the Nobeyama Radio Observatory. Suzuki, herself a discoverer of interstellar molecules, died in an automobile accident in 1987.

Ceramic Membranes

"Ceramic" and "membrane" don't seem a likely pair of words, but Marc Anderson of the University of Wisconsin at Madison believes they have a promising future together. Anderson has been making ceramic membranes by partially fusing particles of oxides such as titania. The result: a porous material that can be supported on stainless steel or clays to form a stable, crack-free membrane. Anderson thinks ceramic membranes could outperform polymer-based membranes in high-temperature or extreme chemical environments. Other potential applications include fuel cells, photocatalytic degradation of water contaminants, and sensors. Anderson described ceramic membranes as "something a ceramist would probably throw away, because rather than being a dense, compact material, these materials are full of small pores. But the ceramist's litter is our gold."



Chemical oxymoron? *A ceramic membrane formed by fused oxides on a clay support.*

■ PHILLIP SZUROMI