Chemistry

Oxygen gets superconducting powers

Oxygen, essential for life and one of the most abundant elements on Earth, has now acquired another distinction. It is the first gas to be made superconductive, a team of researchers in Japan reports. "This experiment is a big advance [toward] hydrogen, which is theoretically expected to be a superconductor in the metallic state," says Katsuya Shimizu of Osaka University.

Shimizu and his colleagues chilled oxygen almost to absolute zero and squeezed it in a diamond anvil cell (SN: 10/26/96, p. 261). At nearly 1 million times atmospheric pressure, the gas becomes a metal and loses its electrical resistance, they report in the June 25 NATURE.

To demonstrate superconductivity, the researchers connected metal electrodes to the tiny, solid oxygen sample. They had to design a layer of aluminum oxide to insulate the oxygen and electrodes from the metal chamber that held the sample, says Shimizu. —*C.W.*

Test can find traces of drugs in milk

Dairy cows that are routinely dosed with antibiotics to fight infections often excrete those medications in their milk. Now, two researchers at the University of Maryland, Baltimore County, have shown that a technique called pulsed electrochemical detection can quickly assay those substances.

The method uses a gold electrode to detect the sulfur atoms of antibiotics such as ampicillin and cephapirin. The electrode quickly gets contaminated, so each second, a pulse of current must clean it off, preparing it for the next measurement. The new technique can detect drug concentrations as low as 1 part per billion, well below the Food and Drug Administration's limits for milk, says William R. LaCourse. He and Catherine O. Dasenbrock report their findings in the June 1 ANALYTICAL CHEMISTRY.

Currently, experimenters must use chemical methods to extract the antibiotics from milk, techniques that can be either time-consuming or not very sensitive, says LaCourse. Pulsed electrochemical detection still requires some chemical separation of the milk, but it cuts the analysis time from 8 hours to 2 hours. Next, LaCourse hopes to miniaturize the test device, making it even faster, more sensitive, and more direct. —*C.W.*

Bubble factory for petroleum catalyst

Researchers at the University of Illinois at Urbana-Champaign have developed a new way to make tiny crystals of molybdenum sulfide, a material that the petroleum industry uses to remove smelly sulfur compounds from gasoline. To produce the particles, the scientists pass high-energy ultrasound waves through a solution. This process creates hot bubbles that collapse, triggering a chemical reaction (SN: 4/29/95, p. 266).

The new particles are ten times more active than molybdenum sulfide made conventionally, says Kenneth S. Suslick. They even surpass ruthenium disulfide, which is the best catalyst available for removing sulfur from petroleum. Suslick and his colleagues report their findings in the June 24 JOURNAL OF THE AMERICAN CHEMICAL SOCIETY. —*C.W.*

Suslick/JACS

Crystals made by conventional (left) methods and by sound waves creating bubbles that collapse (right).

Earth Science

What aircraft leave behind

As the volume of air traffic soars, scientists have grown concerned about the pollution spewing out the back ends of jets. One long-term study of conditions over Wyoming suggests that airplane exhaust has added substantially to the number of microscopic particles found at high altitudes, possibly helping to cloud the skies.

David J. Hofmann of the National Oceanic and Atmospheric Administration in Boulder, Colo., began investigating this problem in 1976, when one of his meteorological balloons passed through an unusual layer of tiny particles and droplets called condensation nuclei, 75,000 feet above Earth's surface. Because sonic booms occasionally echoed near his research site in Laramie, Wyo., Hofmann suspected that a military jet might have left the trail of particles. He eventually determined that a high-flying reconnaissance aircraft had flown upwind of the region 18 hours earlier.

In the years since, Hofmann and his colleagues have detected hundreds of similar layers between 29,000 and 41,000 feet in altitude, where most jets fly. It is difficult to attribute these bands of condensation nuclei to particular planes because the Federal Aviation Administration doesn't keep records long enough to be useful to the researchers, says Hofmann. On March 31, 1997, however, a balloon passed through a distinct nuclei layer, which they were able to trace to a Delta Airlines flight from Seattle to Dallas–Ft. Worth. The flight had passed upwind of the balloon about 3 hours earlier, report Hofmann and his coworkers in the July 1 GEOPHYSICAL RESEARCH LETTERS.

From studies of aircraft engine exhaust, atmospheric chemists know that sulfurous gases emitted by planes quickly convert to microscopic droplets of sulfuric acid (SN: 7/6/96, p. 12). Natural sources, such as volcanoes, can also produce sulfuric acid droplets and other minute particles in the atmosphere, but these do not form the thin, concentrated layers that aircraft create, says Hofmann.

Looking back over balloon measurements since 1973, Hofmann and his colleagues found 432 discrete instances of condensation nuclei layers. Unlike the natural condensation nuclei, whose numbers rise in summer, these concentrated bands appear with the same frequency in each season, as do aircraft flights. The steadily rising number of nuclei layers has kept pace with the increasing number of jet flights over the years.

The researchers estimate that aircraft have increased the concentration of natural condensation nuclei over Laramie by about 10 percent. This would have little effect if the tiny droplets from aircraft join up with larger natural ones. On the other hand, plane exhaust could stimulate the growth of cirrus clouds, says Hofmann.

Some researchers have observed an increase in cirrus clouds associated with aircraft contrails, although they have had difficulty estimating the effect of jets on general cloudiness, says Patrick Minnis of NASA's Langley Research Center in Hampton, Va. Cirrus clouds can warm Earth's surface, he notes, and preliminary calculations suggest that the increase in cirrus clouds caused by jets since the 1960s could account for a warming of 0.1°C to 0.3°C in the United States. —*R.M.*

Weather satellite GOES bad

One of the nation's most important weather satellites is close to death, but satellite operators have a backup craft on hand. The geostationary satellite—known as GOES-9—is one of a pair that beams down the cloud images seen on television as well as temperature data used in weather forecasting. The National Oceanic and Atmospheric Administration (NOAA) aims to have two GOES satellites in operation at all times to get full coverage of the United States and surrounding ocean areas. The newest craft, launched last year, finished its testing phase in June and will soon take over for GOES-9, NOAA announced last week. —*R.M.*