chemistry notes

Gathered at the meeting of the American Chemical Society in San Francisco

SUPERMETALS

Fifth state of matter

The fifth state of matter, long postulated by scientists, may have been attained in recent experiments with carbon, Nobelist Willard F. Libby reports.

The four known states of matter are solid, liquid, gas and plasma, the last being a dense cloud of ions and electrons.

Under ultrahigh pressure, matter could achieve a fifth state, becoming a supermetal. In effect, the pressure, millions of times that of the atmosphere, squeezes the atoms so hard that the electron structure is disrupted. In this condition, the matter would be somewhat like metals, in which the nuclei of atoms remain fairly stationary but a number of atomic electrons are free to move about.

This is what conceivably happened, says Dr. Libby, who is professor of chemistry at the University of California, Los Angeles, in experiments in which a slab of graphite was placed between two slabs of high explosives and the explosives were fired simultaneously. As a result, small diamonds were produced.

"It is difficult, from our knowledge of the chemistry of carbon, to imagine that a diamond molecule of some 100 million carbon atoms can be made in less than a thousandth of a second," Dr. Libby says. The process could have involved throwing the system into a supermetallic state for the brief instant of ultrahigh pressure, during which the diamond could have been formed, he said.

SMOG

Irritant component isolated

A potent eye-irritating component of gasoline has been identified in an artificial smog chamber in the General Motors Research Laboratories.

The compound, peroxybenzoyl nitrate, had not been identified as an eye irritant before, reports J. M. Heuss and Dr. W. A. Glasson. In fact, it hadn't even been known to exist.

The researchers found that some kinds of hydrocarbons, such as benzylic hydrocarbons, caused more eye bother than others when converted to Los Angeles-type smog. They went after the more irritating types to identify the substance responsible, and came up with peroxybenzoyl nitrate.

PLASTICS

Metallized polymers form ionic bonds

Hard, high-temperature plastics that use a different kind of chemical bonding than other polymers have been developed by Monsanto Co.

The new plastics have a mixture of metal oxides that allows the atoms in the substance to be held together by ionic bonds, reports chemist Lawrence E. Nielsen.

Polymer plastics consist of molecules which are long chains of submolecules linked together. To improve strength and other qualities, bonds called cross-links are sometimes added between individual chains.

Most cross-linking is done with hydrogen atoms, which form a rather weak bond, or with covalent bonding, in which electrons are shared between two atoms.

Ionic bonds between atoms in a molecule are formed when an atom tends to lose or gain electrons more or less permanently. An atom that has lost an electron becomes a positively charged ion, and attracts a negative ion that has gained an electron. Metals tend to form ionic bonds of this sort.

Although ionic bonds are only about as strong as covalent bonds, plastics held together by the latter type have relatively few cross-link bonds. The new plastics, says Dr. Nielsen, have an ionic bond between a metal ion and every second carbon atom in the polymer chain.

The ionic plastics are formed by mixing powdered acrylic acid copolymer with powdered zinc, barium, calcium or lead oxide. The mixture is heated to 300 degrees C. at 10,000 pounds per square inch.

The new polymers are still under development and are not commercially available. They might be used as construction materials.

SANITATION

Dividing the water supply

Some Americans drink polluted water while others sprinkle their lawns with what's practically mountain spring water, a North Carolina sanitary engineer claims.

The solution, says Dr. Daniel A. Okun of the University of North Carolina, is a dual water system: one kind for drinking and the other for washing, flushing and other uses.

Both water supplies would be sanitary under his program, says Dr. Okun, so there would be no danger of poisoning someone who carelessly drank utility water.

The drinking water would be taken from high-quality sources such as upper-valley reservoirs fed by streams, springs and precipitation, before it has been exposed to industrial or urban contamination. The secondary water could be reconditioned from sources that had been contaminated but could be purified by chemical or other means.

As examples, Dr. Okun compared Philadelphia, which takes its water from the Delaware River after it has passed through various industrial areas, and New York, which gets its water from high quality reservoirs in the upper Delaware Valley. A more rational system would reserve the scarce high quality water for drinking in both areas.

High quality drinking water is needed because while treated water may have no bacterial contamination, it does contain increasing amounts of chemical pollutants. The long-term effects of continual intake of chemicals, combined with air pollution and food contamination with insecticides, just isn't known, says Dr. Okun.

Replacing present systems with dual pipes might be prohibitively expensive, but starting from scratch the dual system costs just about the same, he claims. The place to start is in new cities and suburbs, and in planning regional water systems to set aside separate drinking water supplies.