TECHNOLOGY

Light pipe scopes skin contamination

Workers suspected of being contaminated with toxic coal-tar components and coal-gasification byproducts have traditionally been examined by eye using a hand-held "black" lamp. Its ultraviolet radiation caused suspect polycyclic aromatic hydrocarbons (PAH's) to glow. Now researchers at Oak Ridge National Laboratory have refined the concept for greater sensitivity and safety.

Their unpatented "luminoscope" hooks a two-way fiber-optic cable to a low-intensity near-ultra-violet light and an electronic photomultiplier. As it pans a surface, the 365-nanometer UV sets PAH's and other materials fluorescing. Even glows too small to eyeball are picked up, says Richard Gammage, one of its developers. Their portable 11-pound version costs $2,000. Another under construction will attempt to read fluorescence spectra to help viewers decide whether a glow's source is toxic or not.

Holey cathodes

A class of synthetic transition metals has attracted attention at Bell Telephone Laboratories as possible cathode sources for rechargeable lithium batteries. The lightest metal, lithium, provides more atoms for reaction per unit weight than do most competitors. Though commercial nonrechargeable lithium batteries have been around for years, finding the proper cathode for rechargeables has proved difficult. Bell Labs researchers think intercalation may hold the answer.

Intercalation is a process whereby donor ions position themselves inside a host structure. These ions occupy otherwise vacant regions — as water fills holes in a sponge — without changing the structure of their host. What's more, just as a sponge can be wrung dry, intercalation is generally reversible.

Several structures allowing intercalation are under study at Bell Labs. Titanium disulfide, for instance, possesses a layered structure. Though strong chemical bonds exist within layers, each of which are only three atoms thick, bonds between adjacent layers are weak, making intercalation of lithium ions possible. For vanadium oxide, intercalation occurs within open "anthill" channels running through the compound. And niobium triselenide, a compound composed of atoms bonded in parallel strings, absorbs lithium between its strings.

In the discharge cycle, a lithium atom on the anode releases an electron to its external circuit. The resulting lithium ion then diffuses into an adjacent electrolyte bath and swims toward the cathode, which in turn picks up such an ion by intercalation. Within the cathode, these ions take back an electron from the external circuit. Reversing the cycle recharges the cell.

The lithium cells are both long-lived and rapidly recharged. And the high voltage of experimental cells — one to three volts each — together with their low-weight electrodes, result in as much as a four-fold increase in energy over other rechargeables.

A microcomputer for every freshman

Within five years, every freshman at Carnegie-Mellon University in Pittsburgh, Pa., will receive a microcomputer as part of the university's orientation program, according to the Oct. 13 COMPUTERWORLD. The school's goal is to make all students — from the liberal-arts major to the budding engineer — more familiar with computer technology and comfortable with the coming microcomputer revolution (SN: 10/18/80, p. 246).

With their microcomputers, students will be able to reach CMU's eight-computer network from virtually any location. CMU eventually hopes to expand the program to include terminals planted strategically throughout the university, each capable of providing interactive computer graphics.

PHYSICAL SCIENCES

Meissner effect in an organic compound

When Denis Jerome and his co-workers announced the first observation of superconductivity in an organic compound (SN: 4/5/80, p. 212), the persistent question raised about the claim was whether they had observed the Meissner effect, the expulsion of magnetic field lines from the material when it was in the superconducting state. They had not. They had evidence of superconductivity from different kinds of electrical behavior.

The caution was raised that those effects might be taking place on the surface of the sample and the superconductivity be the property of a contaminant, not the material in question. Meissner effect is a bulk effect and tends to show that the superconductivity is a bulk property of the sample. Meissner effect in Jerome's compound, ditetramethyltetraselenafulvalene-hexafluorophosphate ($[TMTSF]_2PF_6$), is reported in the Oct. 27 PHYSICAL REVIEW LETTERS by a group from Bell Telephone Laboratories in Murray Hill, N.J. (K. Andres, F. Wudl, D.B. McWhan, G.A. Thomas, D. Nawalajek, and A.L. Stevens).

The experiment subjected crystals of $(TMTSF)_2PF_6$ to the conditions under which Jerome and associates found superconductivity, 12 kilobars pressure, 0.9 K temperature, and tested its response to applied magnetic fields of strengths up to 100 oersteds. For fields less than to approximately 3 oersteds they found a 50 percent Meissner effect. Some of the behavior they have noted is unusual, but their final conclusion is that "$(TMTSF)_2PF_6$ under pressure is a bulk superconductor in near-zero field which exhibits rather unusual and very anisotropic properties in applied fields."

Fractal proteins

Fractals, geometrical figures with fractional dimensions between 1 and 2 and 2 and 3, are developing applications in a variety of scientific and other problems from mapping to music making (SN: 3/22/80, p. 187). An important mapping problem in biophysics and biochemistry is the structure of protein molecules. Fractals are applied to them in some recent work published in the Oct. 27 PHYSICAL REVIEW LETTERS by H.J Stapleton, J.P. Allen, C.P. Flynn, D.G. Stinson and S.R. Kurtz of the University of Illinois at Urbana-Champaign.

They come to this proposal by analyzing their own and other experimenters' data on three protein molecules, myoglobin azide (MbN_3), ferricytochrome *c* (CC) and cytochrome P-450 from *Pseudomonas putida* (CP 450). The starting assumption is that each of these molecules is composed of some number, N, of identical basic units linked together in a particular way. The linear extent of the final molecule, which depends on how the linkages are made and whether there are any folds or bends, etc., is related to the number of basic units, N, through another number, which is defined as the fractal dimensionality of the structure, because it is determined by how the basic units of the molecule arrange themselves.

Earlier work has led to the suggestion that a model with a "fractal dimension" of two would fit, but now studies of a physical property influenced by the structures, the behavior of electron energy states in triply ionized iron in these molecules, leads to a conclusion that the fractal dimension for all of them is a truly fractal 1.65 ± 0.04.

This number happens to be very nearly the decimal equivalent of 5/3, which is the fractal dimension of the geometric figure called a "self-avoiding random walk (SAW)." Myoglobin makes a good analog to a SAW, the researchers point out, with its non-self-intersecting character and its sinuous backbone. A confirming experimental study, of X-ray data on the locations of the so-called alpha-carbon atoms in myoglobin, finds that their distribution can also be related to a dimensionality of 5/3.