Conductive polymers get closer to home

Easy-to-process polymers that conduct electricity are edging closer to large-scale commercialization. Researchers envision many novel uses, including antistatic coatings for delicate electronic equipment, lightning protection for airplanes, spark-resistant clothing for people working near explosive fumes, and shields to block electromagnetic radiation emitted from computers and TVs.

For years, processing and stability problems have limited conductive polymers to small-scale specialty applications. Two scientists now say they have modified a conducting polymer so that it appears free of such problems. "We have a very simple process here in a very simple polymer," says physicist Arthur J. Epstein of Ohio State University in Columbus, who did the work with chemistry graduate student Jiang Yue. Their report appears in the March 28 JOURNAL OF THE AMERICAN CHEMICAL SOCIETY.

Polyaniline — a molecular chain in which benzene rings alternate with nitrogen-centered amine groups — serves as the starting material for the new conducting polymer. Epstein and Yue first convert this backbone into an insulating form and then chemically bond acidic sulfonate groups to half of its benzene rings. In a process known as doping, the sulfonate groups enhance polyalinine's conductivity by contributing negative charge to nearby nitrogen atoms, freeing other electrons in the molecule to travel down the chain. By processing the polymer so that millions of chains line up side by side, the Ohio team and others can make materials in which conduction electrons can almost always avoid dead-ends by hopping to adjacent chains. Epstein says the sulfonated polyaniline maintains its conductivity even when dissolved in water.

Other polymer researchers are taking different paths toward the same destination. Materials scientist Paul Smith of the University of California, Santa Barbara, says he prefers to dope the polyaniline by allowing chloride or other ions to diffuse into the polymer rather than going through the chemical step of bonding dopant molecules or atoms directly to polymer molecules. Epstein contends this "external" type of doping poses problems that his "self-doping" tactic circumvents. For instance, he says, external dopants can leach out of polymers exposed to heat or moisture. He and Smith concur, however, that their contrasting tactics provide healthy competition for hastening discoveries.

In either case, it will take industrial commitment to turn the gram-scale quantities made in basic research labs like Epstein's and Smith's into the kilogram quantities needed for larger-scale commercialization. Hexcel Corp., a high-tech materials company based in Dublin, Calif., took a step in that direction on Feb. 28 when it announced its intention to develop methods for the first large-scale production of polyaniline. A spokesman for Hexcel says the company already has produced batches in the several-kilogram range. — *I. Amato*

Trimming heart disease risk

Middle-aged men who adopt healthy lifestyle changes can significantly reduce their risk of dying from a heart attack a decade later, researchers report.

Follow-up data on the Multiple Risk Factor Intervention Trial (MRFIT) show that the death rate from cardiovascular disease was 8.3 percent lower among the 6,428 men randomly assigned to a special treatment group — focusing on four heart-healthy habits — than among the 6,438 men who received no special treatment during the 10-year trial. Cardiovascular disease is a broad category that includes heart attack, stroke, hypertension and related conditions. In narrowing the analysis to lethal heart attacks, the researchers found a 24 percent drop in deaths among the treatment group compared with the usual-care group.

Participants were 35 to 57 years old and at high risk of heart disease due to smoking or high blood cholesterol when recruited in the early 1970s. Researchers instructed those in the treatment group to lower their intake of saturated fat and cholesterol and to lose weight; they also placed the men in smoking-cessation programs and prescribed medication for high blood pressure. Men in the usual-care group received advice and/or treatment from their regular physicians only.

Scientists reported initial results in 1982 after observing the men for an average of seven years. At that time, the small number of deaths limited the trial's statistical power. Now, the team's analysis of the 10-year mortality data shows some statistically significant results, among them the 24 percent decline in heart attacks. The findings appear in the April 4 JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION.

"We think the evidence points in the direction of a benefit from an intervention program such as this," says one of the principal investigators, Marcus O. Kjelsberg of the University of Minnesota in Minneapolis. While the data do not establish the relative benefits of the various lifestyle changes, they do run counter to recent suggestions that low-cholesterol diets offer no cardiovascular advantage (SN: 3/3/90, p.132). Kjelsberg acknowledges the limitations of a male-only study, but he says he believes intervention programs would also help women cut their risk of heart attack. □

Ancient magnolia DNA reveals plant's past

The climate in northern Idaho was generally pleasant in those days. So maybe it was just an autumn breeze that freed this particular magnolia leaf to carve its final path through the air, land on a lake surface, then sink about 25 feet to the cold, mucky bottom.

Compressed under the weight of accumulating silt and sequestered from the degrading forces of oxygen and heat, the leaf "just sat there," Charles Smiley says. It sat for almost 20 million years — long after the lake had disappeared — until the University of Idaho paleobotanist and his colleagues peeled back the remaining layers of water-saturated shale, exposing the still-green, unmineralized fossil to the warm rays of a forgotten sun.

The researchers photographed their remarkable find, quickly ground it to a fine powder with some dry ice prepared for just such an occasion, then subjected the sample to sophisticated genetic testing. When it was over, they had decoded an 820-piece DNA sequence from the leaf's photosynthetic organelle, the chloroplast — by far the oldest bit of genetic material ever analyzed, dating back to the Miocene epoch.

Their successful dissection of such ancient DNA (the previous record was from a 13,000-year-old ground sloth) promises a wealth of information, these and other researchers say. Sequence analysis of DNA from long-extinct organisms allows scientists to gauge mutation rates over millions of years. These values, which taxonomists otherwise must infer from modern specimens, are critical to understanding evolutionary trends and to determining the degree of relatedness among modern plants and animals.

In their study of the Miocene magnolia, the researchers confirmed the notion that the common photosynthetic molecule known as rubisco has changed very little over millions of years. Of the 820 DNA subunits, or base pairs, tested with the polymerase chain reaction, only 12 had mutated. That finding led the team to modify the family tree connecting modern magnolias and the tulip poplar tree. The results of their work, led by Edward M. Golenberg of the University of California, Riverside, appear in the April 12 NATURE.

Few spots in the world have experienced the right combination of conditions needed to preserve such ancient specimens, Smiley says. But the Idaho site holds remains of about 100 other plant and animal species with modern relatives, and analyses of their DNA may well provide surprises. "It's a fantastically important site" with the potential to provide "one blockbuster finding after another," he says. — *R. Weiss*