CHEMISTRY

Julie Ann Miller reports from the meeting of the American Chemical Society in Chicago

Manganese deficit may cause seizures

A trace metal deficiency may be at the bottom of many cases of epilepsy. Yukio Tanaka and colleagues at St. Mary's Hospital in Montreal report they find very low levels of manganese in the blood of children and adults suffering from convulsions. One-third of the 100 children and all three adults showed a significant deficit. The deficiency might result from inadequate diet or from an inability to absorb manganese in the gut. Encouraging preliminary results indicate that oral administration of the trace metal can control seizures, Tanaka reports.

Earlier studies showed that female rats deficient in manganese during a critical period of pregnancy gave birth to offspring unable to coordinate voluntary muscle movements. Mothers of two of the convulsive children also showed low blood manganese levels. Tanaka would like to see tests for manganese performed routinely on pregnant women.

Many factors have been suggested as causes of seizures, so manganese deficiency may be responsible for only a fraction of the problem. "We do not claim at this time that we have found the cause of or cure for epilepsy," says Tanaka. "However, we believe we have opened up a whole new field of inquiry into the convulsive disorders and that we have a very good chance to help at least some epilepsy patients."

Solids conducive to new technology

"Organic metals" are tantalizing chemists and physicists both with the challenge of understanding unusual properties and the potential for novel technological applications. Most solids composed of an array of molecules are good insulators, instead of conductors, because electrons associated with one molecule cannot jump to another. But the new materials are surprisingly good conductors, and their conductivity is strictly temperature dependent. Although they conduct electricity, these solids retain organic characteristics (such as solubility in organic solvents) that may offer a number of new industrial possibilities.

Although the first molecular metal, TCNQ (7, 7, 8, 8,-tetracyano-p-quinodimethane) was prepared more than ten years ago, how such solids transport charges is not completely understood. Researchers from a number of university and industrial laboratories now report synthesis of new materials that they hope will be both theoretically enlightening and commercially useful.

Joel S. Miller and Arthur J. Epstein of the Xerox Webster Research Center report fabrication of a series of TCNQ solids with differing numbers of electrons but the same gross structure. The alterations change the electrical and magnetic properties of the material. Brian Hoffman and colleagues at Northwestern University announced the successful preparation of a broad new class of organic metals. They find that oxidation of disk-shaped molecules called metallo-phthalocyanines leads to crystals composed of tall stacks, like towers of poker chips. Preliminary results indicate a metal-like conductance that falls abruptly at a temperature that varies with the crystal. Besides being made of cheap chemicals that are readily available (phthalocyanines are currently used commercially as pigments), the new material is amenable to a wide range of chemical modifications. "This opens up a prospect of true molecular engineering in the field of conducting solids," Hoffman says.

A conducting polymer is another entry in the class of new solids. Alan J. Heeger and co-workers at the University of Pennsylvania find that electrical conductivity of long chains of polyacetylene can be varied by factors of up to 100 billion by addition of small parts of bromine and iodine. This "doped" polymer can be used in a circuit as a substitute for a metallic wire, Heeger says. He foresees polymeric derivatives being used as both semiconductors and as highly conducting sheets, films and wires. But the greatest value of these new solids, the scientists emphasized at a press conference, will probably be not to replace copper, but to permit development of completely new devices based on the unusual properties. And, the researchers point out, all the interesting properties have not yet been identified.

Catalytic units: Troubles in the air?

While catalytic converters for automobiles promise less polluted air, they may eventually release a potent poison into the atmosphere. Although so far the Environmental Protection Agency has measured no significant amount of the element palladium escaping from converters, Rajendra S. Bhatnagar is concerned about future large-scale use and disposal of the devices. In research at the University of California at San Francisco, Bhatnagra finds that palladium binds to many cell components. It blocks the action of numerous enzymes, interferes with energy use in muscles and nerves, induces lung malfunction and appears to cause abnormailities in fetuses. Very low concentrations of palladium can have drastic effects; for example, one part per million in blood causes immediate coagulation. Si Duk Lee of EPA suggests industry and government may prevent future problems by recycling catalysts or controlling converter disposal.

Membranes snare SO_2

Membranes of manufactured macromolecules are often used in separation processes; for example, the removal of salt from water. A new approach be scientists at Allied Chemical Corp. uses such specialized membranes to produce acids and bases from salts and water. Successful small-scale pilot studies have now been completed for the technique's first practical engineering application: removal of sulfur dioxide from the gas emitted by power plants. The researchers, Kang-Jen Liu, K. Nagasubramanian and F. P. Chlanda, project that operating costs for the new process will be 35 to 43 percent less than those for current methods.

In the new technique, bisulfite, which is the product of sodium dioxide dissolved from the waste gas into an absorber solution, is channeled into two compartments of a "water splitter." On one side of the synthetic membrane, the bisulfite combines with hydrogen ions to produce sulfurous acid and then divides into water and concentrated sulfur dioxide. Sulfur dioxide in this form can be sold as a liquid or processed further to sulfur or sulfuric acid. On the other side of the membrane, the bisulfite combines with hydroxyl ions and sodium to produce sodium sulfite, which can be reused to absorb sulfur dioxide from more waste gas. A large-scale demonstration of the technique is planned for next year and Liu expects full commercial applications in about two years.

The new membrane technique will probably find applications in other processes that generate or utilize sulfur dioxide, such as sulfuric acid manufacture and ore smelting and in a variety of processes that use an acid-base cycle, according to Liu. "The use of water splitting for acid-base generation potentially can lead to more energy-efficient operations, conserve natural resources and reduce byproduct formation," the researchers say.