One-way molecules channel electric current

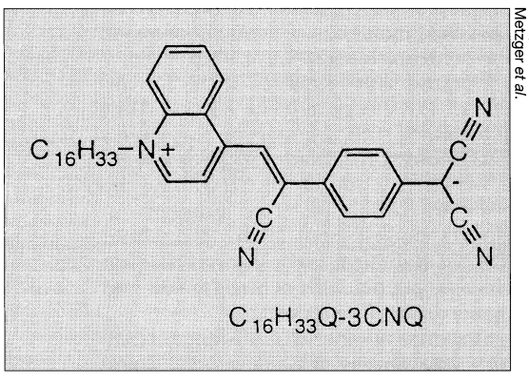
Individual molecules acting as wires and switches offer a promising avenue to a world of integrated-circuit chips crammed with electronic devices.

Researchers now report success in synthesizing and manipulating a type of molecule in which electric current flows much more easily from one end of the molecule to the other than it does in reverse. The asymmetry means that the molecule acts as a rectifier and could be used as an electronic component known as a diode.

Robert M. Metzger of the University of Alabama in Tuscaloosa and his coworkers report their findings in the Oct. 29 JOURNAL OF THE AMERICAN CHEMICAL SOCIETY.

"A great deal is happening in molecular electronics," says James C. Ellenbogen of MITRE Corp. in McLean, Va. It appears that Metzger's group has taken "a significant step forward by demonstrating diode behavior in a molecule or a molecular monolayer."

The results also represent experimental verification of a rectification effect predicted in 1974 by Ari Aviram of the IBM Thomas J. Watson Research Center



Metzger et al.

Molecular structure of hexadecylquinolinium tricyanoquinodimethanide.

in Yorktown Heights, N.Y., and Mark A. Ratner of Northwestern University in Evanston, Ill. "They have finally demonstrated the concept," Aviram says.

Metzger and his coworkers used molecules of hexadecylquinolinium tricyanoquinodimethanide, originally studied a few years earlier by J.R. Sambles of the University of Exeter in England and his colleagues. The Metzger team succeeded in sandwiching a one-molecule-thick layer of the material between aluminum electrodes. The molecules are all oriented with the negative charge adjacent to the same electrode.

Applying a potential of about 1 volt across the molecular film, the researchers observed much more current flow in one direction than in the other. "It's certainly not the sturdiest device, but it is stable," Metzger says. Indeed, it was possible to do repeated measurements on the same molecular layer.

However, the setup "raises the question of how one can be certain that just one molecule is responsible for the behavior," Ellenbogen says. "I would like to see this molecular diode behavior exhibited by a single molecule embedded in a circuit made by a single molecular wire."

Further experiments are needed to confirm and extend the results. "It's not very hard to do, once you know what you're doing," Metzger says.

Mark A. Reed of Yale University and his colleagues have recently reported an alternative approach to fabricating molecular wires and measuring electric conductivity directly through only a small number of molecules. "Just by slapping two different metals on different sides of a molecule, you have a rectifier," Reed says.

Researchers hope these discoveries will be borne out by additional experiments. "We are attempting here in my group at MITRE to build upon such work by fabricating a molecular electronic adder circuit that uses such diodes for switching," Ellenbogen says.

The MITRE team has prepared a design and expects to start fabrication experiments next year. Says Ellenbogen, "If [the Reed and Metzger] experimental results are accurate, then the molecule we have designed should be able to add two numbers." *—I. Peterson*

New schizophrenia therapy shows promise

Hopes for improving the treatment of schizophrenia, a debilitating mental disorder, rest mainly on continuing innovations in antipsychotic medications. Now, a new study suggests that over the long haul, individual psychotherapy tailored to strengthen interpersonal skills and control social stress markedly helps many people suffering from the disorder.

This new form of schizophrenia treatment, dubbed "personal therapy," resulted in lower relapse rates and progressively better social functioning over 3 years, at least for people able to live with family members and meet basic survival needs, contend social worker Gerard E. Hogarty of the University of Pittsburgh School of Medicine and his colleagues.

"If a new medication had treatment effects of the same magnitude as those reported by Hogarty's group [for personal therapy], it would be seen as a major advance and adopted as the main drug treatment for schizophrenia," remarks William T. Carpenter Jr., a psychiatrist and schizophrenia investigator at the Maryland Psychiatric Research Center in Baltimore. "Unfortunately, the influence of this new finding will be severely muted because it involves a psychosocial approach."

Personal therapy operates on the theory that stress-related emotions worsen symptoms of schizophrenia, such as delusions, hallucinations, social withdrawal, and apathy (SN: 10/25/97, p. 261).

In this approach, a therapist first helps a person to notice his or her physical and emotional reactions to stress and teaches various strategies for coping with and relaxing in the social arena. After a year or more of weekly sessions, the therapist encourages the person to more actively engage others at work and in the community and presents more advanced social skills, such as identifying and dealing with criticism from others.

Hogarty's group recruited 151 people hospitalized for their first episode of schizophrenia. Upon leaving the hospital, each volunteer was maintained on some form of antipsychotic medication and assigned at random to 3 years of personal therapy, family therapy (which teaches all family members how to live with a mentally ill relative), or supportive meetings with a nurse who monitored drug effects and offered general encouragement.

Among the 97 participants who lived with their families, those who received personal therapy experienced far fewer recurrences of severe schizophrenia symptoms and took their medication with greater regularity than those in the other two groups, the scientists report in the November AMERICAN JOURNAL OF PSYCHIATRY.

Personal therapy recipients living with their families also displayed improved social adjustment over the entire 3-year period, whereas family and supportive approaches yielded more modest social improvements that occurred only in the first year of treatment.

However, among the 54 individuals who lived alone or with nonfamily members, schizophrenia symptoms reappeared and worsened most often for those receiving personal therapy. People living independently of their families tended to start out with particularly severe symptoms and found it difficult to secure housing, food, and clothing on their own. As a result, the demands of personal therapy may have overwhelmed them, the researchers suggest.

It remains unclear whether the new data on personal therapy will affect how clinicians treat schizophrenia, especially in light of current financial constraints. Moreover, future studies are needed to evaluate the method's effectiveness in combination with new antipsychotic drugs, assert psychiatrists Wayne S. Fenton of Chestnut Lodge Hospital in Rockville, Md., and Thomas H. McGlashan of Yale University in an accompanying comment. *—B. Bower*