# Building a chemical transistor on a chip

A group of chemists has constructed a chemical device that behaves like a solid-state transistor. Consisting of an array of three microscopic gold electrodes mounted on a silicon chip, covered by a thin film of conducting polymer and immersed in an ion-containing solution, the new device relies on a chemical reaction for its ability to amplify electrical signals. In contrast, solid-state transistors depend on the movement of electrical charge within solid, semiconducting materials to achieve the same result.

The synthesis of a primitive chemical transistor demonstrates that a chemical system, in which a molecule-based material is the active element, can be synthesized to achieve a specific electronic function, says Mark S. Wrighton of the Massachusetts Institute of Technology (MIT). Such devices could eventually be used as sensors and in "molecular electronics" (SN: 6/11/83, p. 378). However, note Wrighton, Henry S. White and Gregg P. Kittlesen in the Sept. 5 JOURNAL OF THE AMERICAN CHEMICAL SOCIETY, "The molecule-based transistor reported here has no immediate practical application."

The key ingredient in the chemical transistor is the conducting polymer polypyrrole. By removing or adding a few electrons, the material's conductivity changes by a factor of more than a million. "If you apply an electrical signal that removes or puts in charge, you can achieve a change in the resistance of the material," says Wrighton. "We're exploiting the fact that polypyrrole becomes a conductor when oxidized and an insulator when reduced." Thus, a small electrical signal applied at one electrode can control the flow of a much larger current between the other two electrodes.

The device built by the MIT team is smaller than comparable solid-state transistors. The closely spaced gold electrodes are only 3 micrometers wide and 0.12 micrometer thick, while the polypyrrole film has a similar thickness. However, the chemical transistor takes about 10 seconds to cycle from "off" to "on" to "off"—far longer than the billionths-of-a-second switching times achieved in solid-state transistors. In a molecule-based device, the on-off time depends on the rate of the chemical reaction involved. In the absence of oxygen, the transistor survives several days of use.

"We want to make it faster," says Wrighton. "We want to make the signal you put in a chemical [rather than electrical] signal. We want to make other kinds of devices." The researchers are now trying to construct a diode using an arrangement of two different polymers. —*I. Peterson*

# Radar polarizes weather community

Turbulence is building between Ohio researchers and the National Weather Service over a radar system that accurately measures rainfall and can distinguish hail from rain. The system, called dual-polarization radar (SN: 5/30/81, p. 344), was developed five years ago by Thomas A. Seliga, director of the atmospheric sciences program, and co-workers at Ohio State University in Columbus. Since then, the researchers have been pushing for the radar's inclusion in NEXRAD, the next-generation weather radar (SN: 6/7/80, p. 361), set for full deployment in the 1990s.

But the weather service has been cool to the idea. "We don't want to add any additional features [to NEXRAD] until we're very sure they are ready and indeed provide a significant benefit commensurate with their costs," explains Anthony Durham, director of the NEXRAD program office in Rockville, Md.

As currently envisioned, NEXRAD could detect storms, but without a polarizing capability it would be unable to quantify raindrop size and number. It would also be unable to distinguish clearly between hail and rain. Seliga's group reports in the Sept. 14 SCIENCE that, in Colorado field tests conducted in 1983, the dual-polarization technique enabled researchers to accurately pinpoint pockets of hail within a rainstorm.

While conventional radar signals are polarized in a single direction, Seliga's system looks at two dimensions of a raindrop or hailstone. The signals reflected from hail are about the same in each dimension because hail is irregularly shaped and often tumbles as it falls. But falling rain is elongated in the horizontal direction, thereby reflecting more horizontally polarized signals than vertically oriented ones.

Seliga estimates that dual-polarization radar would add 5 percent to the projected $20 million cost of each NEXRAD station. The benefits, he says, would include better prediction of hailstorms, which experts say destroy $700 million in U.S. crops each year, and less soil erosion due to better rainfall measurements.

The NEXRAD program office recently asked the two competing engineering firms working on preproduction models to specify design changes required by dual polarization. A decision on the cost-effectiveness of such changes will be made in 1985, three years before the first NEXRAD units are scheduled for delivery. Durham says that NEXRAD could be expanded to include polarization at any time and adds that the weather service will keep an eye on dual-polarization experiments in the future. —*S. Weisburd*

# Hormone markers for homosexuality?

State University of New York (SUNY) researchers have found what they believe may prove to be a physical correlate to homosexual behavior—a difference in the biological response to a sex hormone. The researchers note that the study suggests "that biological markers for sexual orientation may exist."

But they caution that their work, reported in the Sept. 28 SCIENCE, does not address the question of what causes homosexuality, nor do all homosexuals show the same response.

"There's a good possibility there's a biological element involved with sexual orientation," says Brian Gladue, one of the authors, "but it's a long way from saying that it's determined biologically."

Gladue, who moved from SUNY's Stony Brook campus to North Dakota State University in Fargo, and colleagues Richard Green and Ronald Hellman studied 17 heterosexual men, 14 homosexual men and 12 heterosexual women. Heterosexuals chosen for the study reported erotic fantasies about and intercourse with only the opposite sex since puberty, while the homosexuals reported only male fantasies and intercourse.

The researchers monitored the response to injections of estrogen, which in women prompts a slight drop, then a sharp rise, in luteinizing hormone (LH), a substance produced by the brain. LH changes in men are much more muted.

Comparing male homosexuals to heterosexuals, they found that the homosexuals' LH pattern was in between the male heterosexuals' and the females': Four days after the injection, when the women's levels were 200 percent of their baseline values, the heterosexual men averaged 88 percent while the homosexual men had levels 138 percent of baseline. "Although not all the homosexual men studied showed an enhanced response of LH to estrogen compared to the heterosexual men, significantly more did," they report.

Similar research was done in East Germany in the early 1970s, but the work was never fully accepted.

The SUNY study has provided other researchers with food for thought. Says Sue Kiefer Hammersmith, a sociologist at Indiana University in Indianapolis and coauthor of a 1981 Kinsey report on sexual preference, "As we learn more about possible biological roots, I think we need to reexamine our whole view of homosexuality....I think it's important to recognize there is a range of natural human diversity.

"This report is important for establishing for American scholars the existence of homo/hetero differences in metabolic responses that had been reported in earlier German research. It's a very interesting development."