New alloy brightens solar-cell prospects

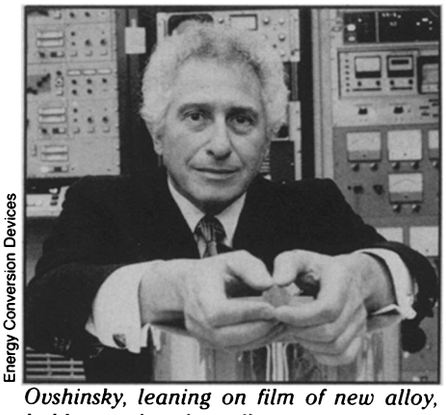
Stanford R. Ovshinsky, the electronics entrepreneur whose pioneering work with amorphous materials catapulted him to fame 10 years ago, now claims that he can market solar cells that by 1981 could generate electricity at costs comparable to rates for power from conventional coal-fired and nuclear powerplants. It's quite a claim and one he readily admits will only be possible with outside funding, perhaps from the government.

The basis for his optimism is a silicon-based alloy developed by his firm — Energy Conversion Devices, Inc. — and reported in the Nov. 30 issues of NATURE and NEW SCIENTIST. Unlike the solar cells used to power satellites in space, his (still under development) are made from amorphous materials. As their name implies, their molecular structure is random. In contrast, the silicon used in ordinary solar cells is a pure crystal, its structure orderly. Although the energy-conversion efficiency of crystalline cells is very high — generally about 12 to 14 percent — the precise and difficult crystal-growing and -cutting processes they require make them expensive.

Cost is no trivial matter. To harness diffuse solar rays economically requires being able to blanket rooftops, even acres, with inexpensive materials. Amorphous semiconductors, inexpensive and simple to make, offer just that potential.

This week Ovshinsky told SCIENCE NEWS that ECD's measurements on the new alloy indicate that it has "at least a 10 percent [energy-conversion] efficiency and probably higher." Assuming a 20-year lifetime for solar cells, he said ECD could market cells "within three years" at 50 cents a peak watt, or the equivalent of about 5 cents per kilowatt-hour. If true, it would be competitive with the going rate for electricity — costing an average of 3.92 cents per kilowatt-hour nationally — but varying locally from about two to nine cents. It's also a steep drop from the $8 to $10 per peak watt that crystalline silicon cells cost today.

What's more, Ovshinsky's alloy was designed to incorporate the advantages of both the amorphous and the crystalline silicon cell while avoiding some problems associated with each. For example, by adding fluorine and reducing the hydrogen content in the alloy recipe, the semiconductor's band gap was increased, and with it the proportion of the solar spectrum that can be converted to useful energy. At the same time, "localized states," those vexing electron traps that impede conductivity, have been reduced by at least an order of magnitude over the best silicon-hydrogen amorphous semiconductor, Ovshinsky says.



Energy Conversion Devices

Ovshinsky, leaning on film of new alloy, holds sample solar cell.

This meant the material could be "doped" — deliberately impregnated with impurities such as phosphorus to improve the conductivity — to the same *effective* parts-per-million level as pure-crystal silicon semiconductors. A resulting increase in the material's theoretical energy-conversion efficiency brings it to that of the single-crystal silicon solar cell — about 25 percent, he said.

The new alloy also eliminates three important physical problems associated with the more well known amorphous silicon-based materials:

- photostructural changes — generally reversible but undesirable materials changes resulting from exposure to light,
- hydrogen losses — nonreversible chemical changes caused as bonds, that should lock in hydrogen, break under heat. Ovshinsky said this can degrade both its quality and potential lifetime,
- and scratchability — unlike the new alloy, conventional silicon-hydrogen materials scratch easily and are unstable mechanically, Ovshinsky says, "while ours is exceptionally scratchproof, exceptionally inert chemically and exceptionally stable."

What does the Department of Energy think of Ovshinsky's alloy? It "could be quite promising," said Paul Maycock, DOE's photovoltaic-program manager in Washington. He and other DOE officials met with Ovshinksy Monday. Although Ovshinsky didn't indicate any interest in DOE support at the meeting, his work looked impressive enough that DOE would gladly consider an unsolicited research proposal from ECD, Maycock said.

Ovshinsky also seemed impressed by what he termed the "encouraging" encounter. Until experimental results for his alloy were published, Ovshinsky says, "We weren't able to discuss it in any scientific manner. And we of course did not want to give up [patent or licensing] rights in order to have the pleasure of the government's money." But as a result of the briefing, Ovshinsky says, "We feel we will be doing something with DOE now."

DOE is funding 17 contracts for solar-cell research involving amorphous semiconductors, 12 of which are for silicon and silicon-hydrogen materials. Chemical recipes for two of the 12 "are very similar" to Ovshinsky's, Maycock said, although those programs are just beginning. Ovshinsky's reason for thinking that amorphous semiconductors have good photovoltaic prospects is "the same reason that we're spending your money on these other 17 programs," he added. □

Monumental Alaskan land protection

Under the Antiquities Act of 1906, President Jimmy Carter designated parts of Alaska as 17 new national monuments to protect scientific, cultural, historic and living resources no longer available anywhere else in the United States. Included in the 56 million acres are:

- the nation's largest unpolluted river valley, called the Noatak;
- portions of Mt. McKinley, the nation's highest peak;
- the Wrangell-St. Elias mountain range, the nation's largest group of peaks towering over 15,000 feet (it contains a glacier larger than Rhode Island);
- what remains of the Bering Land Bridge, the place where humans may have first entered the New World;
- more than 110 gravel beach ridges containing an archaeological record of human habitation going back at least 4,000 years;
- Admiralty Island, site of the nation's largest remaining virgin forest;
- the Yukon Flats, nesting sites for millions of migrating waterfowl; and
- the Becharof lands, the prime habitat for Alaskan brown bears.

All were among the more than 140 million acres for which the Carter administration proposed protection last year. Although the House of Representatives passed a bill that would have protected much of that land (SN: 5/27/78, p. 343), a similar measure stalled in the Senate under threat of an end-of-session filibuster.

Interior Department Secretary Cecil D. Andrus said, "Use of the Antiquities Act was confined to those areas whose values were most clearly of the scientific and historic sort." However, come the opening of the new Congress in January, Alaska lands legislation (including these monuments) will be reintroduced with hopes of extending protection to those previously proposed conservation units that were not designated monuments.

Subsistence hunting by rural Alaskans, including Indians and Eskimos, will be permitted on all parcels except the Kenai Fjords, where there is no record of recent subsistence use. Sport hunting will be allowed on two national-forest monuments and in two to be managed as wildlife refuges. All monuments will be closed to mineral leasing and mining. □