Energy

Solar bear technology

What's white and black and warm all over? A polar bear under the Arctic sun.

The polar bear is almost a perfect solar converter, says electrical engineer Richard Grojean of Northeastern University in Boston. The bear's fur efficiently conducts ultraviolet light to its black skin, where the energy is absorbed and helps maintain the bear's body temperature. Grojean, who has been studying polar bear physics for more than a decade, is now working with a colleague, Gregory Kowalski, to see if similar principles can be used to design efficient solar collectors for cold climates.

A polar bear's hairs are completely transparent. The bear appears white because visible light reflects from the rough inner surface of each hollow hair. However, the hairs are designed to trap ultraviolet light. Like light within an optical fiber, the radiation is conducted along the hairs to the skin. This summertime energy supplement provides up to a quarter of the bear's needs. Thus, even while actively pursuing prey, the bear can still concentrate on building up its blubber layers in preparation for winter.

Two other qualities make polar bear fur an attractive model for a solar collector. This fur collects ultraviolet light coming from any direction. And, while the skin is warm, the temperature at the pelt's outer layer is about the same as the bear's surroundings. "He loses very little heat," says Grojean.

Eskimos have long known about these properties. An Eskimo never dries a polar bear pelt with its skin against the ground; the ice under the pelt would melt and later freeze the pelt to the ice. Instead, pelts are dried with the fur against the ground. "The pelt is a sort of thermal diode," says Grojean. "The energy flows only in one direction."

What's needed now is a more detailed study of the properties of polar bear hair, says Grojean. This would suggest the characteristics that, say, hollow quartz fibers should have to duplicate the bear's system. One important need would be to find a way to shift the absorbing region from ultraviolet to visible light, where more solar energy is available.

"We're not predicting that we'll be covering the roofs of buildings with fur," says Grojean. "But if we know what the properties are, then we'll know how to structure an equivalent system."

Innovations for energy efficiency

A variety of research projects, still in the early stages of development, could repay small investments with large increases in energy efficiency, suggests a new report from the National Academy of Sciences, based in Washington, D.C. The report, "Innovative Research and Development Opportunities for Energy Efficiency," highlights seven research areas, including heat transfer, materials processing and sensors.

One interesting topic is the chemical synthesis of materials. Instead of the "heating and beating" of bulk materials in traditional metallurgy, methods are now being developed for producing more uniform materials by starting at the molecular level and building up. Another exciting new technology is the preparation of strong, defect-free cements that are as tough as cast iron. In these new cements, polymers replace some of the water normally used.

However, the Department of Energy, which originally requested the report to guide its funding of energy conservation research projects, no longer has the funds to do so. "It's an awful situation," says chemist R. Stephen Berry of the University of Chicago, who helped compile the report. Moreover, industry is not stepping in to fill the gap, he says. Increasingly, U.S. researchers may seek collaborators in countries like Japan where such research is supported more strongly.

Science & Society

Materials project is summit spin-off

Later this year the rapidly growing Versailles Project on Advanced Materials and [materials] Standards, known as VAMAS, will sever itself from the multilateral organization that spawned it. On Jan. 30, the United States and France became the first signatories to a memorandum of understanding that will give the project its independence.

A major international research program, VAMAS is one of the most successful of 18 technical projects initiated by the June 1982 Economic Summit of Versailles, in France. The projects were created to enhance trade in high-technology goods and services by summit members: the United States, United Kingdom, Canada, France, Italy, Japan, West Germany and the European Economic Community (EEC). But as an essentially economic, rather than technologic, organization, the Economic Summit never anticipated holding on to these projects for very long, explains Bruce Steiner of the Institute for Materials Science and Engineering at the National Bureau of Standards in Gaithersburg, Md. Since the materials program has come to fill a more valuable niche than its founders had anticipated and "taken on a life of its own," Steiner says, a decision was made to spin it off as an independent venture.

With conventional materials, like cast iron, "one typically has a long experience base" through which a material's general properties, such as melting point, conductivity and ductility, become known, explains Steiner, a member of the VAMAS steering committee. "But with advanced materials – like new polymers, alloys and composites – there isn't this experience base," he notes. Before a firm can decide whether and how to use a new material in its products, not only must the basic reference properties be established but the "standard" tests to measure these properties must also be characterized. One of VAMAS's primary missions, Steiner says, is to cooperatively develop within these nations the internationally reproducible tests and data that will ultimately be used to establish a new material's properties. Until VAMAS came along, he adds, "nothing like this existed."

Roughly $2 million in research is now conducted annually under this project. The programs span 11 areas, ranging from the development of standard wear tests for ceramics and characterization of weld toughness to the analysis of materials that will be implanted as artificial human-body parts.

EPA decides not to ban daminozide

The Environmental Protection Agency (EPA) has decided not to pursue an immediate ban on daminozide, a plant-growth regulator that the agency suspects may be a potent carcinogen (SN: 9/7/85, p. 149). The decision is based partly on the agency's acceptance of a finding by its scientific advisory panel (SN: 10/12/85, p. 230) and the Agriculture Department that existing animal-toxicology studies are not adequate to determine the potential health risk posed by daminozide, according to Jack Moore, an assistant administrator of EPA. Moreover, new estimates by the agency – using the actual percentage of crops treated with the chemical, instead of a maximized, worst-case estimate – suggest that original lifetime-exposure estimates may have greatly exaggerated risk.

However, "because of continued concerns about the potential risk of cancer from lifetime exposure," Moore says EPA is placing conditions on the continued use of this chemical. They include a reduction in the amount of daminozide that can be applied to apples, the primary crop on which it's used, and the amount of chemical residue that will be allowed on fresh apples and apple products. In addition, the agency has given Uniroyal Chemical Co. of Middlebury, Conn., sole maker of the product, four years to provide better toxicology data on both daminozide and its potent breakdown product, UDMH.

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