Materials Science

Richard Lipkin reports from San Francisco at a meeting of the Materials Research Society

Let there be 10 percent light

Silicon solar cells, which turn sunlight into electricity, have for many years run into two roadblocks: converting light into electric current efficiently and cheaply.

For a solar cell to be useful on a large scale, it must convert at least 10 percent of the light energy it receives into electricity. But the cost involved in raising efficiency above 10 percent has proved prohibitive. One method, single-crystal silicon, ranks high in efficiency but also high in cost.

So scientists are seeking to make thin-film, amorphous silicon cells—for instance, by spraying silicon compounds onto a plain metal backing. This keeps the cost down, but it often lessens efficiency.

However, materials scientist Subhendu Guha of United Solar Systems Corp. in Troy, Mich., says that his company has licked both of those problems at once. His research group has figured out a way to mass-produce thin-film, silicon-alloy solar cells that produce electricity at a stable 10.2 percent efficiency.

"We call it a roll-to-roll deposition process," Guha says. "We take a stainless steel roll half a mile long and 14 inches wide, then run it through a machine that deposits the silicon-alloy thin film. This system substantially reduces production costs."

Once cut from the sheet, the resulting solar cell — a 5-millimeter-thick sandwich — has a silicon-alloy surface and two layers of silicon and germanium. Guha says a factory will open next year to roll out solar modules by the mile, priced "substantially below current market levels."

How big a solar cell does one need to light a common lightbulb? "On a good day, the sun delivers about 100 milliwatts of energy per square centimeter onto Earth's surface," Guha says. "That means with 10 percent efficiency, for 100 watts of power, you'll need a panel about a meter square."

Hazardous waste gets a microwave cleaning

It cooks up popcorn, pizza, and Lean Cuisine in a flash. So why not use microwave heating to destroy hazardous wastes?

With hazardous waste mushrooming around the country, scientists are searching for better ways to break down its most dangerous components. Sometimes the goal is to destroy lethal mixtures, other times to recover useful materials, says Steven J. Oda, who serves on the board of the International Microwave Power Institute in Manassas, Va.

Improved microwave heating methods can break down air pollutants, degrade radioactive sludge, disinfect hospital trash, reclaim printing and dry-cleaning solvents, reactivate spent carbon, and clean up contaminated soil, Oda says.

To remove water from radioactive sludge, microwaving "means less handling of hazardous waste, minimizes risks of airborne contamination, saves time and energy, and avoids large capital and operating costs of conventional alternatives," he points out.

In Japan, new microwave methods eliminate solvents used in reprocessing nuclear fuel. In Russia, microwaves evaporate liquids from radioactive wastes, then melt the remaining solids into special glass for storage or burial. In France, scientists clean up incinerator ash with microwaves.

In the United States, old electronic circuits — in computer parts, semiconductors, and so on — have become a mounting source of hazardous waste. With microwaves, researchers can recover gold, silver, copper, and other precious metals, then melt the remainder into "durable glass frits," Oda notes.

To clean up contaminated earth, he says, microwaves will cook soil soaked with dangerous pentachlorophenols (PCPs) to 1,000°C, destroying 99.9 percent of the noxious chemicals.

"In some cases," Oda says, "microwave heating provides solutions to problems that cannot be solved effectively any other way."

Science & Society

Research reactors win reprieve on fees

Last summer, the Nuclear Regulatory Commission (NRC) imposed tariffs on reactors used for nonprofit research and training: $62,000 in annual licensing fees and additional charges for radioisotopes used in research and medicine. These hefty bills threatened to shut down up to 30 of the nation's 37 university reactors (SN: 8/14/93, p.101), many of which operate on annual budgets of $15,000 to $100,000. But bowing to extensive lobbying that involved numerous phone calls and some 200 letters, NRC announced on March 17 that it will reinstate educational exemptions from the fees.

Last July, Cornell University drafted a petition—signed by 11 other universities — asking NRC to waive the fees. The document argued that because the entire nuclear industry benefits from the training and research carried out at academic facilities, it should pay the cost of regulating university reactors. These arguments—and insights gleaned by commission staff during site visits to the reactors last fall—were pivotal in its decision to rescind the new fees, NRC said.

Water toxicity: What EPA doesn't know . . .

The Clean Water Act charges the Environmental Protection Agency with policing the release of toxic chemicals into the nation's rivers, lakes, and streams. By law, industrial firms may not release anything into these waters without first obtaining an EPA permit to do so.

These licenses to pollute usually carry a series of conditions, such as an upper limit on the amount of each toxic chemical a polluter can release and a requirement that each polluter monitor what it discharges. But a new analysis of federal records by the General Accounting Office (GAO), a congressional watchdog agency, concludes that most of the industrial chemicals discharged into U.S. surface waters are not being controlled by these permits.

GAO auditors focused their analysis on industries manufacturing pesticides, prescription drugs, and pulp or paper. They cross-checked chemicals identified on each of the manufacturers' water-discharge permits with data from federal water-monitoring surveys and federally mandated annual inventories of toxic releases by the companies.

Some 77 percent of the toxic pollutants discharged by these 236 companies were not listed on their permits, GAO notes in its report, released March 23. Indeed, for about 85 percent of the facilities, GAO says, "The majority of the toxic pollutants they discharged were not controlled through the permit process."

Most of these chemicals were not among EPA's 126 "priority" pollutants — theoretically, the most noxious. However, GAO points out, even the nonpriority pollutants reported here "are recognized as human health risks." Since most pollution fell into this second category, GAO concludes that "EPA's emphasis on priority pollutants is of limited value in resolving the [water toxicity] problems faced by the nation."

Feds may archive your E-mail

Watch what you say in your electronic mail—it could become part of our national heritage.

The Federal Records Act requires that U.S. agencies keep copies of all important business correspondence. Though E-mail — increasingly the vehicle of research and policy communications — has so far not been included in this rule, that could change, based on a March 18 proposal by the National Archives and Records Administration.

Responding in part to a lawsuit filed by several public-interest groups, the proposal would force federal agencies to store all incoming and outgoing business-related E-mail. It would not require that missives remain in electronic form or ease access to any covered by secrecy or privacy protections.