Clouds Don't Dim Solar Decathlon

I magine a solar-power competition at which the sun is a no-show. That was the situation for much of the second-ever Solar Decathlon on the National Mall in the center of Washington, D.C. The unusually long spell of cloudy, rainy weather in October made the 18 college teams scramble for every incoming photon.

The U.S. Energy Department sponsored the event, in which student teams from colleges and universities in the United States (including Puerto Rico), Canada and Spain competed to build the most energy-efficient and aesthetically pleasing solar-powered house. The students designed the buildings on their home campuses and then transported them to Washington for a week of contests in ten categories, ranging from architectural design to water heating.

The homes were expected to be easy to live in; power household appliances and home electronics; and provide a comfortable temperature, adequate lighting and hot water. The houses were also required to power a street-legal electric vehicle



Patricia Daukanta

from the electricity generated by their photovoltaic (PV) panels. The students were judged, in part, by the amount of mileage they could put on the vehicle.

Indeed, one of the keys to the University of Colorado's first-place win was their car's high mileage, said Undersecretary of Energy David K. Garman at the October 14 award ceremony. The team racked up 315 miles during competition week.

The Colorado students designed their house to operate in the worst possible weather, said Jeff Lyng, a graduate student in civil engineering who served as Colorado's student team leader. "We don't have the biggest batteries—we just decided we're going to use them [efficiently]," he said.

Colorado's solar

cottage had 32 200-W

efficiency rating of 16.1

percent, plus south-side

awnings with additional

Cornell University, the

second-place finisher, was

the only student-led team

without a faculty member.

The group was extremely

without bright sunshine,

Garman said. California

Polytechnic State Uni-

savvy about operating

PV modules.

rooftop PV panels with an

Patricia Daukantas



In a rare moment of sunlight, the sundial in front of the Polytechnic University of Madrid's house shines in front of a bank of photovoltaic cells.

versity at San Luis Obispo, which came in third, scored consistently well despite having had one of the smallest PV arrays in the competition.

"The weather was terrible because it didn't test our ability to use our house the way it should have been used," said Steve Lee, an architecture professor at Carnegie Mellon University in Pittsburgh, who served as faculty adviser to the tenthplace team Pittsburgh Synergy. Lee's team was a collaborative effort among three Pittsburgh colleges.

Ideally, the teams would have had about 1 kW/m² of solar energy falling on their PV cells and other solar collectors, Lee said. The near-constant clouds lowered the available energy to 200 to 300 W/m^2 for most of the week, with 500 W/m^2 occasionally. But the low levels of sunlight prevented the houses' batteries from becoming fully charged.

Many of the houses used evacuated glass tubes to heat hot water for showers and dishwashers. Paul R. Graham, a master's degree student in architecture at the University of Texas, said the evacuated tubes are safer at ground level than traditional flat-plate solar collectors, which can become very hot to the touch. However, the solar tubes are less effective on cloudy days than PV panels.

—Patricia Daukantas

Linking Silicon to Light

A team from Stanford University has built tiny germanium quantum-well structures on top of silicon—a technology that could help bridge the gap between light and electrons.

Most of today's optoelectronics, such as semiconductor lasers and high-speed modulators, use so-called III-V semiconductors, said David A.B. Miller, director of Stanford's Solid State and Photonics Laboratory. These semiconductors—of which gallium arsenide (GaAs) is a prime example—come from Groups III and V on the periodic table and are well suited for converting electricity to light. However, they are not a good match for silicon-based integrated circuits.



Did You Know?

Three physicists at the University of Rostock, Germany, have created a "soliton molecule" that can travel down an optical fiber (Phys. Rev. Lett. **95**, 143902). The so-called molecule consists of a pair of bright solitons—tightly joined light waves that propagate without dispersion—bound together by a dark soliton. The researchers suggest that this bound state of solitons could be used as a third bit of information, beyond the binary method of 0 (no light) or 1 (a bright soliton).

Patricia Daukantas (pdauka@osa.org) is the senior writer/editor of *Optics & Photonics News*. Silicon, a Group IV element, has fundamentally different properties from the III-V materials and is thus difficult to integrate with III-V semiconductors, Miller said.

The group, led by Stanford graduate student Yu-Hsuan Kuo, grew an extremely thin layer of germanium and silicongermanium quantum-well structures on a silicon substrate (Nature **437**, 1334). These tiny structures about 40 atoms thick—

demonstrated something called the quantum-confined Stark effect (QCSE). A voltage applied across one of the quantum wells will shift the wavelength of the light that the well can absorb to longer frequencies. Varying the electric field thus switches the light off and on.

Kuo and colleagues tested the germanium-silicon structures at room temperature with light at around 1,440 nm and found that the QCSE was actually slightly stronger in germanium, a Group IV element like silicon, than in the III-V materials. "That really was a surprise to us," Miller said.

After submitting their research for publication, the researchers found on



further testing that the effect works for light at the standard telecommunications wavelength of 1,550 nm when the germanium-silicon structures are heated to 90° C—an important consideration when designing devices to work inside the warm innards of a large computer or optical networking hub. Kuo reported that finding at an October 2005 conference in Sydney, Australia.

According to Kuo, Miller and Stanford electrical engineering professor James S. Harris, the germanium-silicon technology could someday lead to the integration of optical modulators and conventional silicon electronics in devices that would have low manufacturing costs.

OPN Remembers

Ronald E. McNair 1950-1986

One of the seven astronauts who died aboard the space shuttle *Challenger* 20 years ago this month was laser physicist Ronald E. McNair. In 1976, he earned a Ph.D. in physics from the Massachusetts Institute of Technology, where he studied energy absorption and vibrational heating in molecules following intense laser excitation. McNair, a former OSA member, also published articles in the *American Journal of Physics* and *Scientific American* on the physics of karate, in which he held a black belt.