NREL Business Ventures

Patented (or Patent Applied for) Technologies Available for License from the National Renewable Energy Laboratory

Technologies Recently Available for Licensing—1999

Steel Weld Weakness Detection

One of the most insidious causes of catastrophic failures of welded steel structures (ships, tanks, bridges, etc.) is hydrogen embrittlement caused by hydrogen incorporating into the weld during the welding process. Until now, a non-destructive way to measure the amount of hydrogen in the welded structure itself did not exist. Even x-ray examination used for particularly critical welds did not detect hydrogen. NREL researchers in collaboration with the Colorado School of Mines (Golden, CO) Center for Joining Technology attacked this challenge by adapting technology that NREL previously developed to detect hydrogen gas leaks. The result is an innovative, non-destructive instrument that quickly and easily detects embrittlement danger by measuring hydrogen concentrations in freshly welded steel structures.

The instrument includes an optical fiber sensor containing tungsten oxide with a palladium catalyst that changes color when it detects hydrogen gas. The sensor is sealed over the weld. Hydrogen gas escaping from the weld causes the sensor to turn blue. A white light source and optical detector attached to the optical fiber measures the intensity of the color change that correlates to the hydrogen concentration in the weld. If the concentration is too high for the steel and structural design loads, the weld can be annealed to reduce the hydrogen concentration to an acceptable level where embrittlement is averted.

Cadmium Telluride Solar Cell Enhancement

Cadmium telluride is one of the most promising materials for manufacturing PV modules with thin-film technology and thereby reducing solar-cell costs. NREL has patented two technologies for adding layers that make the core cadmium sulfide/cadmium telluride (CdS/CdTe) layers more effective. A cadmium stannate (Cd_2SnO_4) transparent conducting oxide (TCO) layer improves electrical conduction and light transmission, and creates a smoother surface than standard tin oxide (SnO_2) front contact layers. A zinc stannate (Zn_2SnO_4) buffer layer improves device performance and reproducibility.

NREL researchers have developed an innovative low-cost, low-energy process for fabricating PV modules that includes these enhancing layers. The cadmium stannate TCO layer, the zinc stannate buffer layer, and the cadmium sulfide window layer of the module are all sputter deposited at room temperature. Then the cadmium telluride is deposited on the layers by close-space sublimation. In contrast to the conventional process that typically requires multiple substrate heat-up/cool-down processing for deposition of TCO, window layers, and the CdTe layer, this new process has a single heat-up/cool-down cycle. Heat treating only one time significantly reduces valuable process time, thermal budgets, and manufacturing costs.

HOMER Model for Choosing Optimal Electrical Systems for Remote Areas

Remote villages and other isolated potential electrical users typically face choosing between very expensive power line extensions and noisy, polluting diesel generators. Renewable energy technologies and especially hybrid combinations of renewable energy with diesel or batteries can, however, often provide attractive alternatives. NREL's "Hybrid Optimization Model for Electric Renewables" (HOMER) software selects the optimal combination of solar cells, wind turbines, diesel, and batteries (or grid extension) based upon specific resources, uses, and costs. "HOMER Express" identifies a general optimal system; "HOMER PRO" makes detailed calculations for designing a specific system; and "VIPOR" will design an entire minigrid for a village. Depending upon the desires of licensees, researchers expect to make "HOMER Express" available free to the public at an Internet site, but to license the two more sophisticated versions of the software for commercial sales or use by commercial consulting entities.

Inner-Flame Matrix Burner

The flame of a gas burner is always on the outside of the burner, isn't it? Not necessarily. NREL researchers have developed a burner that burns uniformly, highly efficiently, and without hot spots on the inside of a cylinder. Such an inward burner should offer important advantages for many uses. Matrix burners use a mat (perforated metal or ceramic sheet) instead of a nozzle to propagate flame. While their use has been relatively limited thus far, they do offer greater flexibility in burner shape and high temperature capability. NREL researchers have succeeded in creating a cylindrical matrix burner that burns inward instead of outward with excellent uniformity of gas flow and burning. Developed to provide back up heat to a solar-thermal-driven Sterling engine, the new technology evenly and efficiently heats the Sterling's sodium heat pipe running through the center of the cylindrical burner. The new technology offers stable high-temperature flames, high efficiency, even heating, and easy recovery of waste heat. Using recovered heat for preheating further reduces air emissions and nitrogen oxides generation, already low because of the burner's efficiency. The new burner technology is ideal for efficient, even heating of any gas or liquid flowing through a tube.

To discuss licensing possibilities or obtain additional information on any of these technologies, call Dave Christensen or Ken Touryan of the NREL Technology Transfer Team at 303-275-3038, or send e-mail to technology_transfer@nrel.gov. For a list of other technologies available for licensing from the National Renewable Energy Laboratory, see http://www.nrel.gov/technologytransfer/lic.html on the Web.

Technology Transfer

Internet: http://www.nrel.gov/technologytransfer/lic.html Phone: (303) 275-3038

NREL

National Renewable Energy Laboratory

1617 Cole Boulevard, Golden, Colorado 80401-3393,
NREL is a national laboratory of the U.S. Department of Energy (DOE),
managed for DOE by Midwest Research Institute, Battelle, Bechtel.
FS-720-26915 • August 1999

Printed with a renewable-source ink on paper containing at least 50% wastepaper, including 20% postconsumer waste