



Ambitious goals: Day4 Energy staff with its high-efficiency 190 W module at the new 7 MW production facility in Burnaby, British Columbia. After expansion to 40 MW in 2007, the company plans to double capacity every year.

Day4 Energy Inc.

The Canadian connection

Day4 Energy electrode gets more from cells

Canadian company Day4 Energy's electrode improves the efficiency of common solar cells by nearly 1 percentage point. Modules made from these cells show an increase in power of 5 to 10 percent. However under the protection of a worldwide patent, the technology cannot become widespread – that is, unless Day4 transforms into the major supplier that company executives envision.

In early May at the PV World Conference in Hawaii, John MacDonald, the CEO of Canadian start-up Day4 Energy, would have preferred not to answer any questions from journalists. The white-haired man, who has actually wanted to retire since 1998, said it was still too early to write an article, noting that module production was not yet up and running and that only the first few prototypes of Day4's new type of module were being manufactured.

But what a difference two months can make. After whetting the appetite of PV enthusiasts in Hawaii by publishing some

scintillating details about a new power-enhancing electrode, the small company based in Burnaby, British Columbia now has divulged that it will begin producing batches of 190 W multicrystalline on-grid modules at its facility in July. The module, which also is expected to complete UL certification in July, features cells from German manufacturer Q-Cells. »We are on the verge of commercial production,« says MacDonald.

With equipment tailored for its unique electrode and supplied by Germany's ACI Ecotec, Day4 Energy plans to produce 2 MW of modules during the remainder of 2006 and ramp up capacity from an initial 7 to 10 MW by the end of the year as laminators are added. For 2007, Day4 is targeting production of 15 MW of modules and a manufacturing capacity of 40 MW. »From 2007 on, we plan to double capacity every year,« says MacDonald. The company, which currently employs a staff of 20, also plans to double its workforce over the next year.

For those made curious by Day4's preview in Hawaii, this comes as welcome news. This new electrode for solar cells should greatly increase the cell efficiency and therefore the module power rating, too – and all that with very little effort. Day4's head of research, Andreas Schneider, presented preliminary results in Hawaii showing that cell efficiencies

could be improved by 0.7 to 0.8 percentage points. The first test modules display power increases of 5 to 10 percent.

There is a certain trick behind this promising surge in power. The bus bars are banished from the surface of the cell, and the back surface field – which reduces the losses on the back side of the cell – can now be spread across the whole space because the need for soldering points for bus bars is eliminated. The electrodes decrease shading on the cell's surface on the front side and reduce series resistance when connecting the cells. The result: an increase in the open circuit voltage by 6 mV and an improvement in the current density by 0.7 mA per cm². And as a bonus, the amount of silver paste needed is reduced by 40 percent, too. According to CTO Leonid Rubin – who initially pioneered the electrode for concentrating photovoltaics in the 1990s after a long career as a physics professor in Moscow – that is »a conservative figure.« A reduction of 70 percent for the required silver is possible, he says.

Low-concentration module

Thanks to the uniform fine contact grid on the surface of the cell, the test modules aren't as sensitive when it comes to cell breakage. The greatly reduced transition resistance between the semiconductor and the metal also allows for concentrated illumination. First tests under a concentration

of 2.9 suns showed a reduction in the efficiency of only 0.7 to 0.8 percent. By comparison, the efficiency of standard modules that were tested decreased by 1.8 percent. Day4 Energy is planning to introduce a low-concentration PV receiver in the second half of 2007 and is exploring models in the 3x to 15x range.

The company will display a 3.5x mirror-based module at the European Union PV conference in Dresden in September. However, concentrating PV will not be Day4 Energy's primary focus. Rather, the focus is on »one-sun modules,« as MacDonald and team call their flat panel. Aesthetics and marketing remain major challenges for all concentrating PV approaches, even if low-concentration systems do not require the ultra-precision tracking accuracy of high-concentration systems. »But if the market wants it, we will have a low-concentration product in 2007,« says MacDonald.

The Day4 Energy electrode is also said to have advantages when processing thin and particularly large cells. That's reason enough for the German cell manufacturer Q-Cells to have committed to the delivery of 104 MW of cells in the next five years.



Special: The module is assembled using cells, which have a copper electrode placed perpendicular to the thin silver contact fingers. The bus-bars are next to the cells.



Day4 Energy's 190 W panels planned for commercial launch in July include 48 multicrystalline cells (6 inch) and have an estimated efficiency of about 14.5 percent.

Unfortunately for the industry as a whole, the question of whether the Day4 Energy electrode will gain wide distribution depends solely on the growth of Day4 Energy. »We do not plan to license the technology,« says MacDonald, adding, »Yes, we are a small company. But we won't stay small for long. We plan to ramp up to become a major supplier of modules in the next three years.« Will this happen? At this point it's too soon for anyone, even MacDonald, to say.

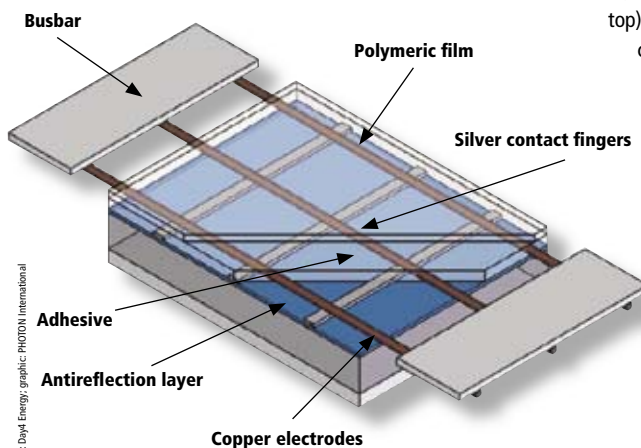
Anne Kreuzmann, Garrett Hering

Day4 Energy electrodes

Day4 Energy has developed an electrode to replace the bus bars on the front side of solar cells. Slightly modified cells are needed for this – obviously, they must not have any bus bars. But they also must not have aluminum/silver pads on the back side of the cells where the bus bars are normally soldered during the regular cell connection process. The cell manufacturer can very easily eliminate one to two production steps in doing this. But it is necessary

to slightly modify the Back Surface Field (BSF) as it can now cover the whole surface because no space is needed for the pads.

Therefore, Day4 Energy requires cells with only contact fingers made of silver on the front side. The electrodes the company developed are then placed over those at a 90° angle. These are made of copper coated in a low-melting metal alloy and embedded in a sandwich of adhesive foil (on the bottom) and polymeric film (on the top). The copper strings are then connected to one- or two-sided bus bars (as shown in the graph) and then are placed next (!) to the cell. When connecting several cells in series, they will be connected to the back side of the adjacent cell. The Day4 Energy electrode is processed at a relatively low temperature of under 200 °C and should allow for higher cell and module efficiencies.



source: Day4 Energy; graphic: PHOTON International