Manufacturing of solar power panels at Deutsche Solar. Photo: Rainer Weisflog

Solar modules head for grid parity

Scientists, plant manufacturers and module producers in Saxony are working on new technologies that can be used to produce solar electricity cost-effectively. The goal is to bring the price down to match that of conventionally generated electricity within the next few years.

by Stefan Schroeter

Susan Conze carefully tips a liquid containing silane onto a small glass plate. Then she places it into a centrifuge, which rotates at high speed, distributing the liquid evenly over the surface of the glass. She then heats the glass on a hot plate until the liquid crystallises into an ultra-thin, slightly uneven layer of silicon. This all takes place in an airtight glove box in a laboratory at the Fraunhofer Institute for Ceramic Technologies and Systems (IKTS) in Dresden. It is hoped that the spin coating process being researched here will make it possible to coat thin-film solar modules with silicon, a semiconductor, more cheaply than at present. In the currently used process, gaseous silane is evaporated onto the glass plates in a vacuum, using sophisticated technology, and considerable energy and time. According to IKTS scientist Tobias Mayer-Uhma, the area most in need of further research at the moment is the organic liquid in which the silane is suspended — a precursor of silicon. 'The silane still needs to be better dissolved in the liquid so that it is more evenly distributed.'

The IKTS scientists see greater potential for optimisation in the thin-film solar modules than in traditional modules made of crystalline solar grade silicon. According to their findings, only 10% of photovoltaic modules are currently being made using thin-film technology. However, they are confident that this technology will experience strong growth, anticipating that photovoltaic modules produced in this way will achieve what is known as "grid parity" – generation of solar energy for the same price as conventionally produced energy — as early as the end of 2010. They are drawing on statements by Frankfurt/Oder based manufacturer First Solar, whose thin-film solar modules, using cadmium telluride as the semiconductor layer, are considered very efficient, reportedly being able to convert up to 10% of the incident solar energy into electricity.

Signet Solar GmbH, based in Mochau, Saxony, is a little more conservative with regard to predictions of effectiveness. It began producing thin-film solar modules with a silicon base in 2008 and believes it will achieve at least 10% efficiency – but not until some stage in the next few years. Matthias Gerhardt, Manager Business Development Europe, expects that Signet's solar modules will be able to deliver electricity at a price comparable to that of backup power, for example from diesel generators, in 2010, and expects to achieve grid parity in 2011 or 2012. Costs could be reduced by continuing to increase the size of the module surfaces while maximising economies of scale.

Robin Schild, chief executive of Dresden plant manufacturer Von Ardenne Anlagentechnik shares a similar view: 'We believe that there is still a big potential to reduce costs in thin-film technology.' Shorter clock cycles for individual process steps and higher deposit rates during coating are just two examples. Von Ardenne is also planning to produce larger modules. The company has just begun producing coating systems capable of manufacturing 1.5 m^2 thin-film photovoltaic modules. 'Now we want to see what our customers think of it,' says Schild. Modules six metres square would be the next potential step. Von Ardenne already has experience in the "jumbo" format, as it builds systems that are capable of coating glass surfaces of up to 20 m^2 . Schild also expects to find further ways to lower costs, even with conventional solar-silicon cells.

Black and white

IKTS is one of several institutes researching ways to do this. One of its projects is to develop new inks and pastes for the power-conducting front contacts of the silicon solar cells. The inks and pastes currently used contain a high proportion of silver particles, which will be partly replaced by cheaper silvered aluminium or copper particles. IKTS team leader Uwe Partsch describes the step in which these conductor tracks are applied to the solar cells as another bottleneck in the manufacturing process. Currently this is made by a traditional screen printing process. After that the conductor tracks are burned onto the surface of the cell. 'We are aiming to improve the energy efficiency by optimising the screen printing process,' says Partsch. IKTS is also working on new, non-contact deposit processes such as inkjet and aerosol printing, which would speed the process up and allow conductor tracks with finer structures. This, in turn, would make it possible for the contacts to cover a smaller portion of the cell surface, allowing for higher electrical yield. The lines are currently 125 micrometre wide, but Partsch hopes to reduce them to less than 50 micrometres within two to three years. Non-contact printing technology would allow for breakage-free production of thinner silicon plates, which use less material.

IKTS scientists believe that cost reductions thanks to improved materials and production processes in the manufacture of crystalline silicon-based solar modules, combined with price increases for conventionally generated electricity could help this form of solar module achieve grid parity from 2015. Frank Asbeck, ceo of Solar World AG, whose Freiberg, Saxony based subsidiary, Deutsche Solar AG, manufactures silicon wafers and solar cells and modules, is even more optimistic. He believes that solar cells will achieve grid parity 'in four years', and as early as 2009 in the US, creating a corresponding impetus for growth in the photovoltaics industry. 'Once we match the price for electricity from the socket, demand will be unstoppable.' Asbeck relies exclusively on crystalline silicon technology: 'We don't believe in thin-film technology.'

Bernd Rau, Senior Vice President Research & Development at Roth & Rau AG in Hohenstein-Ernstthal, does not see things quite so black and white. He believes that crystalline silicon-based solar cells can improve on their current efficiency of 16% to reach 20% in the next two years – even potentially climbing as high as high as 25%. He also expects further increases in efficiency from innovative "hetero cells", which he believes may reach up to 50% efficiency. 'Hetero cells marry thin-film cells with crystalline cells,' he says, 'but it will be a long time before the technology can be mass produced.' At Roth & Rau's well-guarded technical centre, work is already under way on the coating technologies required to produce such cells. Rau promises his customers in the solar industry that they will not need to replace their entire manufacturing line. 'Our aim is to make the technology modular. Our customers will then only need to exchange individual parts of their plant in order to produce a new type of solar cell.' ■

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