oerlikon solar

solar at work

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Dear Readers,

Oerlikon has a very special significance in the world of micromorph tandem technology. It was our Chief Technology Officer, Dr. Johannes Meier, who discovered it in the 1990s, so that Oerlikon can claim to be the birthplace of this process. In addition, we are now on the verge of launching the tandem cell on the market, with the announcement of the first contracts for delivery of turnkey solutions scheduled for the very near future. We are thrilled that we can once again pass a major milestone in the development of solar energy – for the benefit of the environment, our customers, and Oerlikon.
Best regards,

Dr. Uwe Krüger
CEO Oerlikon

Commercial development starts

Micromorph Tandem now!

After major successes with amorphous silicon technology, Oerlikon Solar is now set to take the second generation of thin film solar technology to the market.

The father of micromorph: Dr. Johannes Meier, has been in charge of R&D at Oerlikon Solar since 2003. A physicist by training, Meier is credited with the invention of the dual utilization of sunlight through an amorphous and microcrystalline silicon layer. He loves the outdoors, is an avid piano player, and is also on the team ice hockey for the club HC Le Landeron.

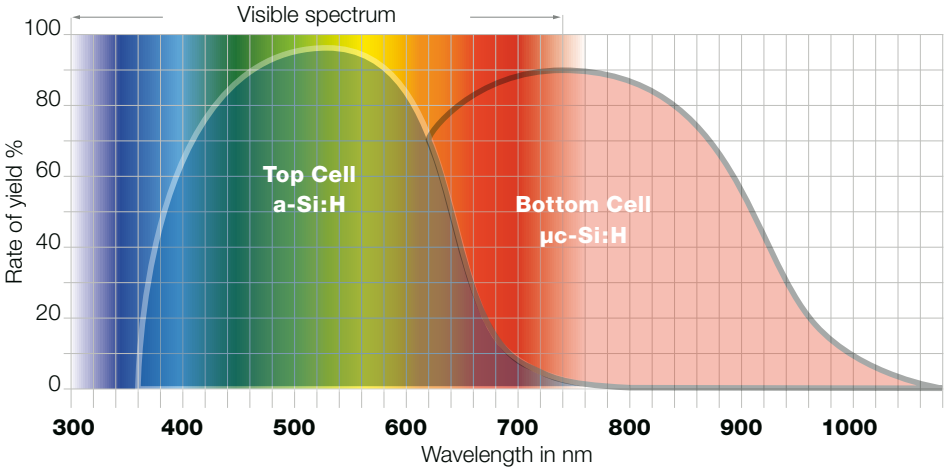
In the near future Oerlikon Solar, a leading producer of turnkey solutions in the area of thin film manufacturing facilities, will also be providing production equipment for micromorph tandem cells. Interest in the market is remarkably strong, with the first contract signings expected in the very near future.

Oerlikon is also in strong demand as a cooperation partner, because Dr. Johannes Meier, the Chief Technology Officer at Oerlikon Solar, is the "father of the micromorph tandem cell." "In the early 1990s the photovoltaic properties of microcrystalline silicon were still unknown. It was assumed that the material would contain too many flaws to be suitable for these purposes. We were able to disprove that notion at the Institute for Microtechnology (IMT) at the University of Neuchâtel," explains Meier. The Swiss physicist served until 2003 as the assistant to Prof. Arvind Shah, who established the solar group in Neuchâtel. For their outstanding scientific contributions in developing the concept of the tandem cell, the two scientists were honored with the Swiss Solar Award in 2005.

Ten percent efficiency

It has been about four years since the photovoltaic expert Meier joined Oerlikon Solar. As the company's CTO he heads the research activities and is in charge of the new laboratories in Neuchâtel and Trübbach. Meier has earned an international reputation in the solar technology world through his many lectures and publications.

Experts around the world regard the micromorph tandem cell as the most promising thin film technology. The term "micromorph" refers to the two different semiconducting materials combined in a cell: microcrystalline and amorphous silicon. Through its dual-layered structure,



High yield: The reason the micromorphic tandem cell is so effective is that its amorphous layer covers the visible spectrum, and its microcrystalline layer traps additional solar radiation in the infrared range.

the tandem cell makes optimal use of the solar spectrum, converting both the visible rays in the 400–700 nanometer range and a portion of the infrared rays (700–1,100 nanometers) into electrical power. As a result, the micromorph tandem cell is 50 percent more efficient than the amorphous cell. Many experts are convinced that this kind of cell will take its place as the toughest competitor for crystalline silicon.

Playing a major role in the advancement towards market-ready micromorph solar modules is the TCO 1200 by Oerlikon, which meets the requirements for the high-efficiency levels of the new technology through the special surface morphology of the deposited layers. The special know-how consists of the ability to ensure a reproducible and homogeneous structure of the individual layers. At the same time, crystalline points must be distributed as uniformly as possible along the entire surface of the solar module.

It is also advantageous that the tandem cell, as envisioned by Dr. Meier, is based on environmentally friendly, non-toxic, and easily available materials. They require 200 times less silicon and only about half as much “gray energy” compared to the crystalline cells. Consequently, thin film cells take just two to three years to deliver the energy consumed in their production, whereas monocrystalline solutions take about twice as long. A major hurdle was the ability to transfer laboratory results to wide-area solar energy modules and to uniformly deposit films across an area of more than one square meter. To achieve this, Oerlikon utilized synergies from the development of reactors to deposit amorphous silicon in large flat screen manufacturing. •

Stable industrial processes

“Size isn’t everything”

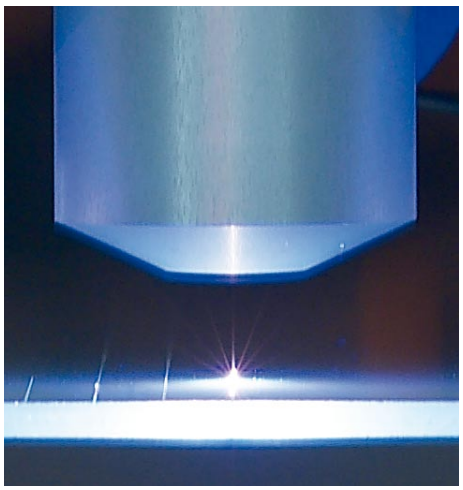
In almost every industrial process, economies of scale play a vital role. Technological advancements in manufacturing lead to increased know-how and larger production runs. These effects ultimately result in lower costs. This logic also applies to the solar industry and in particular to the production of thin film silicon modules. In barely two years Oerlikon Solar has succeeded in establishing the first stable commercial process for large thin film modules. The modules have an area of 1.4 square meters, with larger modules measuring 5.7 square meters currently under discussion.

“We have conducted intensive studies of these possibilities. So far there is no system for depositing TCO films of the necessary quality on glass substrates. Under laser processing the tolerances of the lines become larger. As a result, the active area becomes smaller, resulting either in a loss of efficiency or an increase in costs,” explains Detlev Koch-Ospelt, the head of Oerlikon Solar, pointing out two uncertainty factors.

Problems can also be expected in the encapsulation of the modules, which is already a challenge now at 1.4 square meters, because of the substantial impact of this step on the useful life of the modules. So far, no long-term tests have been published to demonstrate their stability. The required measurement equipment to qualify the significantly larger areas is also not yet available. Another unresolved issue is how such modules, whose weight is a concern in terms of mechanical stability, are to be handled during installation, and in case they need to be replaced.

The large modules that have yet to be realized show significant disadvantages when compared with the proven Oerlikon technology on the basis of fundamental quality and cost criteria. Consequently, size alone does not mean progress. Nor, above all, does it necessarily yield cost benefits. In short: As elsewhere, size is not everything in the solar industry. •

Trailblazer: Detlev Koch-Ospelt, the head of Oerlikon Solar, expects extremely large modules to present problems above all in laser scribing.

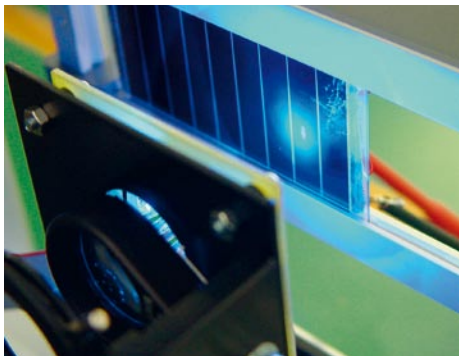


Interview with Prof. Franz Baumgartner, Interstate University of Applied Sciences and Technology, Buchs, Switzerland

Today's efficiency data are misleading

? Professor Baumgartner, efficiency is still the decisive benchmark in discussions on the efficiency of various solar technologies today. Is that appropriate?

Baumgartner: No. The decisive factor is the cost of the solar power. It is common knowledge that you will not find high-efficiency solar cells with top efficiency levels in excess of 20 percent on the roof of any house today, although the world record for crystalline technology set by laboratory cells is now better than 25 percent. For solarmobile racers you can charge prices of about $1,000 per watt for cells with top efficiencies of significantly less than 20 percent, but in mass market applications you can buy at least 200 times that output for the same money. Today's solar module market offers crystalline modules averaging 13 percent efficiency. However, standard crystalline solar modules are sold in a broad efficiency range extending from 10 to approximately 17 percent. Solar module



Test bed: The efficiency of spectral solar power from a thin film test cell is measured for various colors of sunlight.

prices differ very little when benchmarked against output; in terms of effectiveness, however, the differences are substantial.

? Prof. Baumgartner, does a more efficient module necessarily produce more power?

Baumgartner: That is not a trivial question. In practical applications the solar modules reach temperatures of 50–70 °C. All solar cells deliver less energy at higher temperatures – with crystalline silicon cells losing twice as much output. In other words, their temperature coefficient is twice as large as that of thin film modules based on amorphous silicon, for example. Secondly, thin film modules deliver significantly more energy in the case of diffuse and non-perpendicular light than their crystalline counterparts.

A recognized expert: Prof. Franz Baumgartner teaches at the Interstate University of Applied Sciences and Technology, Buchs, Switzerland. His special fields include photovoltaics.

? Can you give us some approximate real-world data?

Baumgartner: Because the modules are evaluated at room temperature in the factory, the nominal output is also defined at a temperature of 25 °C. However, in Switzerland for instance, a silicon-based thin film module with a 100-watt nominal output delivers just as much solar power as a standard crystalline module with a 106-watt rating, simply because of the difference in the temperature coefficients.

? Then why is so much emphasis placed on efficiency?

Baumgartner: Because the media have focused on efficiency in recent years to report on the successes of the research laboratories. But particularly in industrial laboratories the emphasis today is on cost savings, and not primarily on increased efficiency. If we want to achieve a breakthrough in the use of solar energy, we have to make cost benchmarks part of the general discussion.

? What do you see as the key benchmark?

Baumgartner: The price per generated kilowatt-hour of electrical power, because that's the only thing that finances solar generating equipment. As an interim benchmark it is also useful to look at the price per installed watt of nominal output including assembly, the inverter, and other ancillary costs. For a fully installed overall system in the form of a one-megawatt open-area facility today, you would have to budget approximately 4 euros per watt. When standard crystalline silicon cells are used, module costs of approximately 3 euros per watt can be expected. However, thin film solar cells are more economical from the standpoint of the entire system, despite their lower efficiency of approximately 7 percent if the module costs are less than 2.5 euros per watt. And that is no problem, particularly in the case of the Oerlikon thin film silicon concept.

? Where do you see the markets for thin film technology?

Baumgartner: In the coming months and years we will increasingly see a key aspect for the business success of the thin film solar power concept as large-scale generating facilities make their appearance, above all in southern Europe. This is because when the installation costs for the complete solar power system fall below 3 euros per watt – a level that can be expected as of 2010 – grid parity will be achieved in southern Europe. Then the solar power costs there, at approximately 20 cents per kilowatt-hour, will be slightly below what the end customer pays for conventional power from the outlet at home. Then things will really take off! •

"Until 2013 solar power will be the fastest-growing form of renewable energy in China."

Linda Yan, research analyst with the market research firm Frost & Sullivan

Rapid expansion by 2008

A total of 15 new solar fabs

The investment climate in the German solar energy industry is better than ever before. In its current study "Snapshot of Renewable Energies 2007," the international consulting firm Ernst & Young predicts a substantially larger financing volume. Compared with the 400 million euros required in 2006, approximately 1.2 billion euros will be needed to implement all the planned construction and expansion projects this year. "The financial sector and investors have considerable trust in the innovation skills and competitiveness of German solar companies. This is just as important as a reliable political environment," explains Carsten Körnig, the managing director of the German Solar Industry Association (BSW-Solar).

This ensures that the foundation is in place for the ambitious expansion plans of the solar industry, and that Germany's technological leadership will increasingly translate into success on the international market. Roland Berger is another internationally renowned consultancy that sees excellent growth opportunities for solar energy in the power and heating sectors, and outstanding prospects for German solar companies on the world market.

Expansion: The solar industry plans to build most of its new factories in eastern Germany.

According to figures provided by BSW-Solar, no other country can match Germany's density of solar manufacturing and research facilities. In 2007 and 2008 alone, 15 new solar fabs will be built, creating up to 10,000 jobs. "The financial sector has taken notice of the steady growth delivered by German solar companies," explains Robert Seiter, a partner with Ernst & Young Mergers & Acquisitions Advisory in Germany. "The investment focus of publicly listed solar companies is on expansion, massive capacity growth, and intensified research and development efforts." •

Solar energy also needs standards

Germany's leading position, particularly in the photovoltaic industry, owes a great deal to something that gains very little public attention: the intensive and successful work to establish norms and standards. It is carried out at the national level by DKE (the German Commission for Electrical, Electronic & Information Technologies), a joint organization of VDE (the Association for Electrical, Electronic & Information Technologies) and DIN, the body responsible for standards in Germany, and at the international level through the International Electrotechnical Commission (IEC).

"Standards are a basic prerequisite for ensuring that innovative technologies in the renewable energy sector become marketable. They comprise the basis for certification systems that make it possible to market high-quality products and facilitate the knowledge transfer from conventional energy systems already established on the market," explains Thomas Wegmann, the head of international affairs at DKE. "Only if standardization keeps pace with the rapid developments in this field will it be possible for these technologies to continue becoming established."

The DKE Technological Committee 82 has developed the first standards for photovoltaic power generation for both systems and components. Standards have already been established for terms and symbols, corrosion tests, and design and type qualifications of crystalline and thin film systems. The committee will continue with its efforts to move forward rapidly with standards for the sale, maintenance, and disposal of photovoltaic equipment. In addition, it plans to push ahead with the characterization and measurement technology for the innovative thin film technologies. As the world leader among suppliers of thin film production facilities, Oerlikon Solar will be making an important contribution. "Companies involved in the process of developing standards have a definite edge over their competitors," agrees Arno Bergmann, a standardization expert with VDE. •

Solar power facilities keep getting bigger

Since mid-2006 the largest solar facility in the world at present, on the Erlasee estate near Arnstein, Bavaria, in the south of Germany, has been producing electrical power with a peak output of 12 megawatts. In the meantime, however, the plans have become much bigger. In Brandis, to the east of Leipzig, work has begun in Waldpotenz on a solar park with 550,000 solar modules, which will generate approximately 40 megawatts as of 2009. By 2012 China plans to create 100 megawatts in solar generating capacity in the city of Dunhuang at a cost of approximately 600 million euros. And just a year later, in the Australian state of Victoria, a new solar power station will begin feeding the grid with as much as 154 megawatts. •

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