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Christian Buchner is Vice President of Schmid Group's Business Unit Photovoltaics. Schmid's DW PreTex Solution allows manufacturers to adopt diamond wire sawing for multi-silicon.

## Making DW multi a reality

**2017 Technology Highlights award winner:** The most recent development in the competition between multi and monocrystalline has been a major push towards mono, with a series of manufacturers embracing the high efficiency technology. Challenges in texturing diamond wire cut multi wafers have been one of the reasons for this, and Germany's Schmid has stepped up with its DW PreTex solution to solve the problem. Christian Buchner, Vice President Business Unit Photovoltaics for Schmid Group spoke to **pv magazine** after picking up the 2017 Technology Highlights award.

**pv magazine:** Why do you believe the DW PreTex solution impressed the jury?

**Christian Buchner:** I think that if you take a look back at the past cell manufacturers and PV equipment providers have really tried to translate the benefits of diamond wire sawing to multicrystalline PV production. There have been different approaches thrown around – including RIE [reactive-ion etching] texturing using a metal catalyst and additives – for the past two to three years, but it hasn't come into the industry yet. So there are just a few manufacturers that have announced that they will go down this road, but it has not yet made it into mass manufacturing.

With the Schmid DW PreTex solution, we believe that we have hit the right spot, with a very simple, easy-to-use and inexpensive process that can be integrated into mass manufacturing for the texturing of diamond wire sawed multicrystalline silicon wafers. Add to that the fact that the Schmid solution, and perhaps this is the main point as to why the jury was impressed, is the only solution that can be easily installed on to the back end of a wafer manufacturing line. That means that the cleaning stage can be replaced by DW PreTex, and cleaning is required in any event. So it means that the wafers can be shipped to cell manufacturers, which can then use the standard HF/HNO<sub>3</sub> wet-acidic texturing.

**And what can you tell me about the DW PreTex solution? What was the key breakthrough?**

It was that we discovered a very simple process that we already used in the PCB industry, and to transfer it into the PV industry. That was the key development, and we made it work.

**How long was the Schmid team working on this transfer?**

Around two years.

**What kind of volumes have been placed in the market already?**

*“There have been different approaches”*

Right now we basically have the first orders, which then triggered more orders. We have confirmed orders, providing the first machines do work, for around 2 GW right now.

**It really shows how quickly the industry can move.**

It really is exciting because it proves that manufacturers were waiting for a feasible solution.

**Are there similar processes in the market at the moment?**

Not that we know of. That is why we are very cautious about revealing our technology in detail, because there are many competitors of ours that copy processes from German or European manufacturers.

**How does it compare to a dry texturing process?**

There really is no comparison, because our process does not produce black silicon. Our process produces a higher quality than the slurry produced wafers, so that in the end it is difficult to observe the difference in the texturing. But it is a process that comes in at below €0.01/wafer – the total cost of ownership (TCO) – leaving many cents of gain for wafer and cell manufacturers, rather than producing a cell level like black silicon that can lose many of the gains when the cells are incorporated into a module.

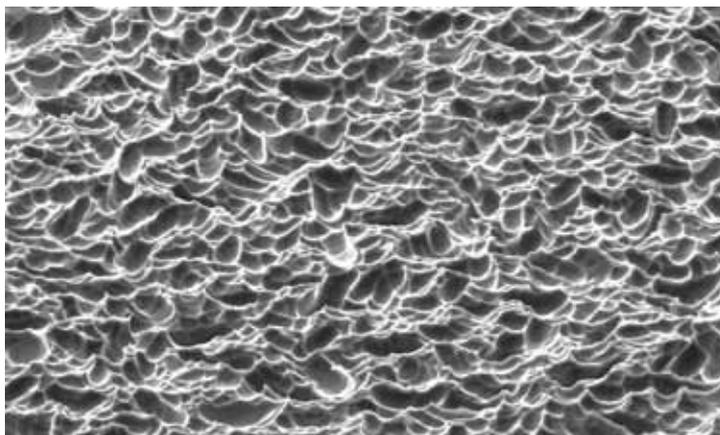
That is why we believe DW PreTex is a much better solution, because it delivers excellent cost savings compared to RIE, and a better performance on the uniformity of the texturing.

**On the process level, how does DW PreTex achieve the low-cost structure?**

It is an inexpensive chemistry and it is an easy wet process system. As I said, it can be dropped in as a final stage of wafer manufacturing. Comparing an entire capex for a slurry [wafer sawing] solution compared to diamond wire plus our texturing, it is the same capex. On the opex side, that is even the same because the cost of final cleaning is not less than DW PreTex. In the end this means that wafer manufacturers are not incurring any additional cost, but they do benefit from the cost savings inherent to the diamond wire sawing process – more wafers, less kerf loss, savings on the slurry material.

**Looking at the c-Si competitive landscape, we are in the middle of a massive push towards monocrystalline production, with some very good efficiencies being achieved with mono PERC. What do you make of the competitive landscape between mono and multicrystalline PV in the market today?**

A year ago I would have answered this question differently. In recent times I have seen a number of [research] publications that have pointed to high performance multi results, from Jinko, Canadian Solar, and others. Additionally, I have come to see that there have been 23%+ performance results on n-type multi,



Schmid's DW Pretex solution roughens the smooth surface created with diamond wire sawing in multi.

which is very surprising to me. The competition right now is really tight again between multi and mono.

This tight competition is particularly evident when you see the cost savings that can be achieved with diamond wire sawing on multi, plus the efficiencies in the last six months or so. I believe the game is open again.

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***“We discovered a very simple process, and we made it work”***

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***But of course, in production today PERC plays a role. There are continuing issues with light and elevated temperature-induced degradation (LETID) on multi PERC, and it is a problem that has not yet been solved by all manufacturers. So that definitely is an advantage of mono.***

Yes, that is true. But I believe that there is now the knowledge of which wafers should be used out of the multi cast block, so that the light and temperature degradation can be prevented. This is the first step, and manufacturers and equipment providers are pushing hard to find a solution. I believe that maybe in the next months, or half a year, there will be a solution available for



Germany's Schmid has developed the DW PreTex solution to allow manufacturers to adopt diamond wire sawing for multicrystalline silicon.

that. Once this happens, PERC will come to multi. And again, maybe n-type multi will be a new game – it is nothing that will come this year, but maybe next. We have seen the first results, and if it does come through then all of the problems with PERC multi will be gone.

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***“That there will be a variety of cell concepts is a good thing”***

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***It does go to show that everything we know in PV cell technology can be turned on its head rather quickly. Would you agree?***

That is exactly true. The competition between multi and mono will continue. Today it is not possible to simply point to one cell concept or wafer type and say that will be the winner. Variety is getting larger, and now we are talking about many different n-type cell concepts and paths to pursue what is already known in p-type. Now that this can also be achieved on multi, well, it is impossible to predict which technology will come out on top. I think to accept that there will be a variety of cell concepts is a good thing, because it will mean that the industry will evolve more quickly.

***How would you describe where Schmid is positioned, as a PV equipment provider, in 2017? Reports are that equipment price competition is very intense, but there do appear to be opportunities in certain areas. How true is that observation?***

That is exactly what we are hoping for. Within the texturing space, edge isolation and other texturing is really at the bottom of prices, as there is tough competition [among equipment providers] out there everywhere. That is why at Schmid we are really happy to have a unique position for one year, or 18 months even [with DW PreTex] and really change something in the industry.

***In what other areas do you see opportunity?***

Other areas include alkaline polishing, which is also a process that manufacturers are taking much more care with, in particular with being environmentally friendly. If manufacturers are changing to mono, as many are at the moment, then rear-side edge isolation and polishing based on alkaline processes could become very popular. Another opportunity is the Schmid multi wire technology on the module line. And also

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***“Competition right now is really tight between multi and mono”***

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Atmospheric Pressure Chemical Vapor Deposition (APCVD), which enables very low cost, high efficiency doping for boron emitters. We really are following our customer requests with these product lines, and the highest efficiencies you see on the market today with n-type is all achieved through using APCVD processes. ♦

Interview by Jonathan Gifford