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The thin-film PV equipment market

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ABSTRACT

As recently as a couple of years ago, solar panels based on thin-film manufacturing technology were being promoted as the low-cost alternative to crystalline silicon. Not only was it cheaper, but thin film also had a convincing roadmap which guaranteed this cost advantage for the foreseeable future. That was 2008, when persistently high polysilicon prices seemed inevitable as demand for solar electricity boomed. We now know that assumption to be false, and although we all knew polysilicon prices would fall eventually, no one predicted the speed and magnitude with which they crashed: in the space of several months, prices reached the point where any advantage associated with the lower materials costs of thin-film manufacturing were completely blown away.

Unsurprisingly, this has taken its toll on the market for thin-film PV equipment. Sales fell by 18% in 2010 against an overall PV equipment market which grew by 30%. It is tempting to conclude that crystalline silicon has won the battle and that thin-film technology will have to be satisfied with serving niche markets from now on, but a closer look at what happened in 2010 shows that the market for thin-film PV equipment is on a recovery track, much of which is being driven by innovations from the equipment suppliers.

The good news is that polysilicon prices are stabilizing and the free ride that everyone in the crystalline silicon cell and module market enjoyed from falling materials costs is over. This brings the focus firmly back onto improvements in manufacturing technology and getting cell efficiencies up. Thin-film manufacturing has the advantage in that it potentially has the greater upside to improve cell efficiency, but the downside is this sector does not have access to the same level of resources as crystalline silicon.

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Putting this into perspective, revenues from sales of crystalline silicon-based modules were 10 times higher than sales of thin-film panels in 2010. Likewise, sales of crystalline silicon-based equipment – excluding polysilicon, ingot and wafering equipment – were double the size of the market for thin-film PV equipment. Ultimately, it could be the lack of access to the same levels of research and development cash that decides just how much of the market thin film can address competitively. However, a lot of work has been done towards getting back on terms and the early signs for 2011 are good: the market for thin-film PV equipment is already recovering strongly, albeit from a low base.

To quantify the situation, the market for thin-film PV equipment reached US$1.4 billion in 2010, down 18% from US$1.7 billion in 2009. This contrasts with a market

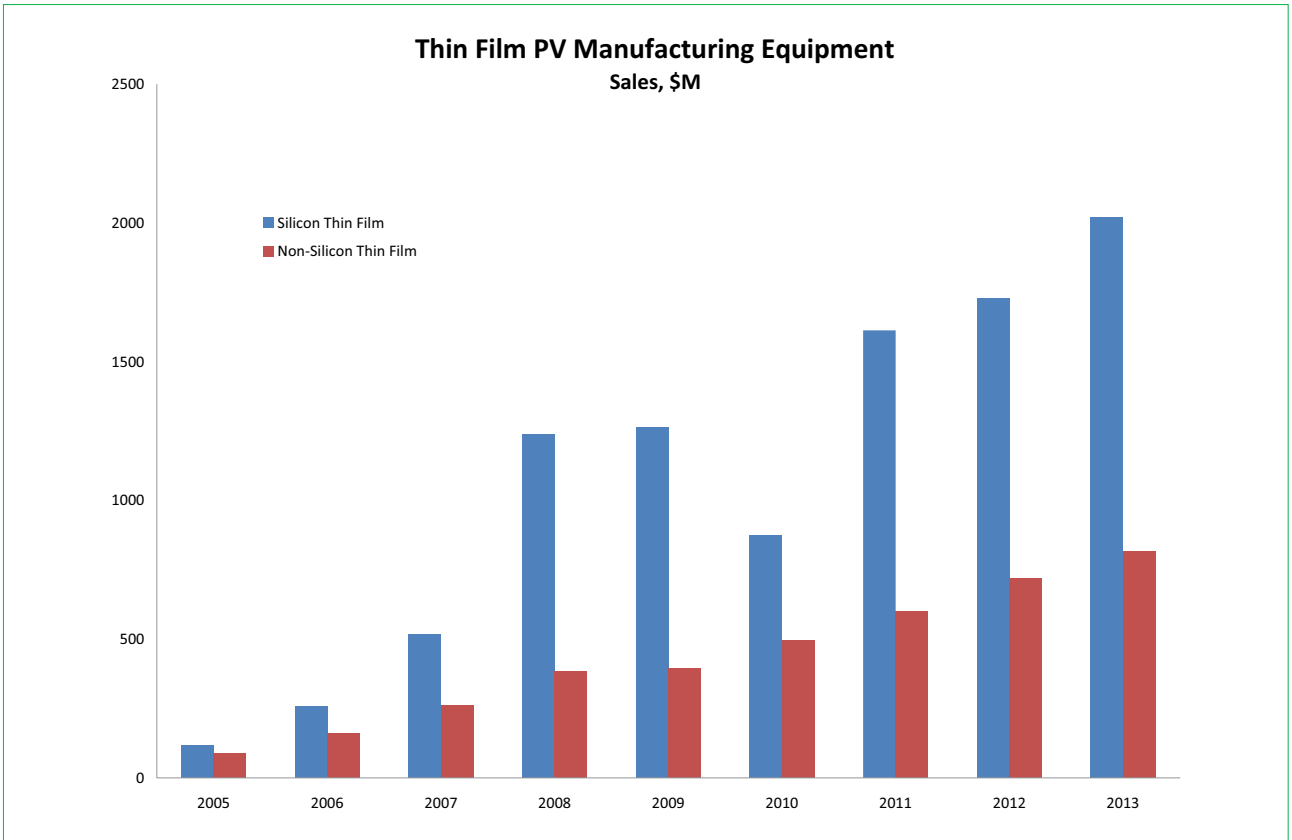

Figure 1. Sales of PV manufacturing equipment (projection to 2013) comparing silicon thin film with non-silicon thin film.

for crystalline silicon equipment which grew 41% from US$5.9 billion in 2009 to US$8.3 billion in 2010, and an overall market for PV equipment, including all PV cell technologies, which grew 30% from US$7.7 billion in 2009 to US$9.9 billion in 2010.

Orders for thin-film PV equipment in the first quarter of this year are already significantly up from last year and capital expenditure announcements made by thin-film panel manufacturers indicate that demand for thin-film PV equipment could grow in excess of 60% and reach record levels in 2011. This increased level of activity is being confirmed by suppliers of materials, components and subsystems who are reporting shipments of large volumes to thin-film equipment vendors. Clearly, the recovery in this sector is underway.

The market for thin-film PV equipment breaks down into two major segments: silicon thin film on glass and non-silicon thin film on glass, and each of these markets has very different dynamics.

Silicon thin film on glass

The market for amorphous silicon thin-film PV equipment suffered the most in 2010 as polysilicon prices collapsed. Sales of silicon thin-film PV equipment fell from US$1.3 billion in 2009 to US$0.9 billion in 2010, or a 31% fall in demand. To make matters worse, around a quarter of the 2010 revenues were for equipment already shipped in 2009, so in terms of shipments, the market actually fell by 60%.

Inevitably there were consequences and the most high-profile casualty was Applied Materials which announced it was withdrawing from the thin-film turnkey business. Essentially, the SunFab turnkey line was canned, although it is important to note they are still offering individual pieces of thin-film PV equipment and remain hugely successful in the market for crystalline silicon equipment. It is a measure of their success in crystalline silicon that they were still the number one PV equipment supplier in 2010 by a long margin, despite dropping most of their silicon thin-film business earlier in the year.

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Oerlikon Solar, on the other hand, without the distractions of serving multiple markets, has made something of a comeback with their new THINFAB solution. They claim production costs of €0.50 per Watt peak (Wp), which puts them right back in contention. Furthermore, they can roll out some of this new manufacturing technology to their existing customers. It cannot be stressed strongly enough how important this is, as much of the technology for silicon thin-film manufacturing is being supplied by the equipment vendors. As a result, if they want to attract new customers, they have to prove they can provide ongoing support.

While the silicon thin-film industry's two biggest hitters, Applied Materials and Oerlikon Solar, struggled to make headway in 2010, it is surprising to see that there is no shortage of companies actively addressing this market. In particular, Ulvac and Shimazu in Japan continue to do well and the list of Chinese and Korean PV equipment companies is getting longer, many of them going from strength to strength. Companies to look out for in 2011 are China's GS Solar and Korea's IPS/Atto and Jusung Engineering.

Non-silicon thin film on glass (CdTe & CIGS)

In contrast to the silicon thin-film PV equipment market, sales of non-silicon thin-film PV equipment grew in 2010 by 25% from US$0.4 billion to US$0.5 billion. First Solar continues to dominate this sector and while their capital expenditures grew by over 50% in 2010, a large portion of this money was spent on building new factories with the majority of equipment slated to ship

in 2011. First Solar's success and, until recently, the inability of its competitors to make serious inroads into the market meant that sales of this type of equipment were mostly tied to how much First Solar decided to spend on capacity. This is a situation which will change in 2011 as Solar Frontier ramp up their 900MW CIGS facility.

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Despite the lack of big customers for non-silicon thin-film PV equipment, there is no shortage of companies offering individual pieces of equipment and turnkey solutions. The established non-silicon PV equipment suppliers are mostly German companies, such as centrotherm photovoltaics, Leybold Optics, Manz Automation, Pfeiffer, Roth & Rau, Singulus, and Von Ardenne Anlagentechnik. With Solar Frontier making a big push in 2011, we should see Japanese equipment suppliers gaining market share as well as the emergence of new entrants from Korea and China.

One of the features of the non-silicon thin-film market is that customers are expected to have their own manufacturing process as only a few equipment suppliers are able to offer full turnkey solutions. centrotherm photovoltaics and Roth & Rau have developed their own processes; interestingly, Manz Automation is now offering a turnkey solution which includes a proven manufacturing process licensed from Würth Solar. Although it is still too early to say if Manz Automation's business model is going to work, it does provide another solution for companies looking for access to this market.

Conclusion

The market for thin-film manufacturing equipment is dominated by silicon thin film on glass technology: in 2010 this market was almost double the size of the market for non-silicon thin-film PV equipment. It is clear from Oerlikon Solar's turnaround and the emergence of new entrants, particularly in Korea and China, that silicon thin-film will continue to be the main thin-film technology going forward. The trajectory of the non-silicon equipment market, while assured to be upwards, will depend on the success of Solar Frontier and new entrants. The proliferation of solutions offered by equipment vendors in this sector points to some interesting competition in the years ahead.

The real challenge for thin film going forward is staying competitive against crystalline silicon in markets where they compete head-to-head. Further compounding this challenge is the fact that the initial outlay on thin-film PV equipment is considerably higher than that for crystalline silicon, and to counter this, equipment vendors need to get the message across that capital expenditure on thin-film PV equipment as a percentage of the total expenditure over the lifetime of a factory is insignificant. The most important issue to address for the industry as a whole, however, is getting cell efficiencies up and the cost per watt down. All PV cell technologies have the same problem and have their work cut out for them. Now that polysilicon prices are stabilizing, thin-film PV equipment suppliers are back in contention.

About the Author

John West is the managing director of VLSI Research Europe, a firm focused on market research and economic analysis of technical, business, and economic aspects within the photovoltaic, semiconductor, nanotechnology, and related industries. He has been analyzing the PV capital equipment market since 2006.

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