

4th Workshop on Metallization for Crystalline Silicon Solar Cells

The Future of Metallization – Results from questionnaires of the four workshops from 2008 to 2013

Gunnar Schubert^{a*}, Guy Beaucarne^b, Jaap Hoonstra^c

^a*Sunways AG, Max-Stromeyer-Str 160, D - 78467 Konstanz, Germany*

^b*Dow Corning, Parc Industriel, Zone C, Rue Jules Bordet, 7180 Seneffe, Belgium*

^c*ECN, POBox 1, 1755 ZG Petten, The Netherlands*

Abstract

The participants of the 4th metallization workshop 2013 in Konstanz were asked to share their opinion on the future of metallization for crystalline silicon solar cells like during the previous three metallization workshop in Utrecht (2008), Konstanz (2010) and Charleroi (2011).

The question “What is the future of metallization?” is one of the most important questions for the success of crystalline silicon solar cells in future. During the consecutive workshops between 71% and 75% of in average 170 participants have responded to the questionnaires. The participants represent the institutes / universities, material and equipment manufacturers and cell manufacturers. The results are presented in this document.

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* Corresponding author. Tel.: +49 7531 99677 217; fax: +49 7531 99677 444

E-mail address: gunnar.schubert@sunways.de

1. What in your opinion will be the percentage share metallization techniques in solar cell production?

1.1. Results survey 2013

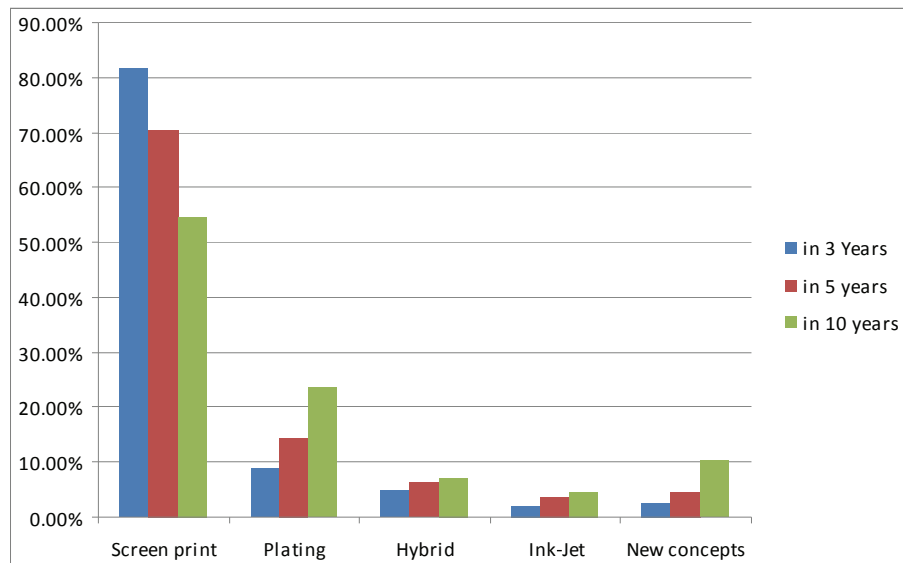
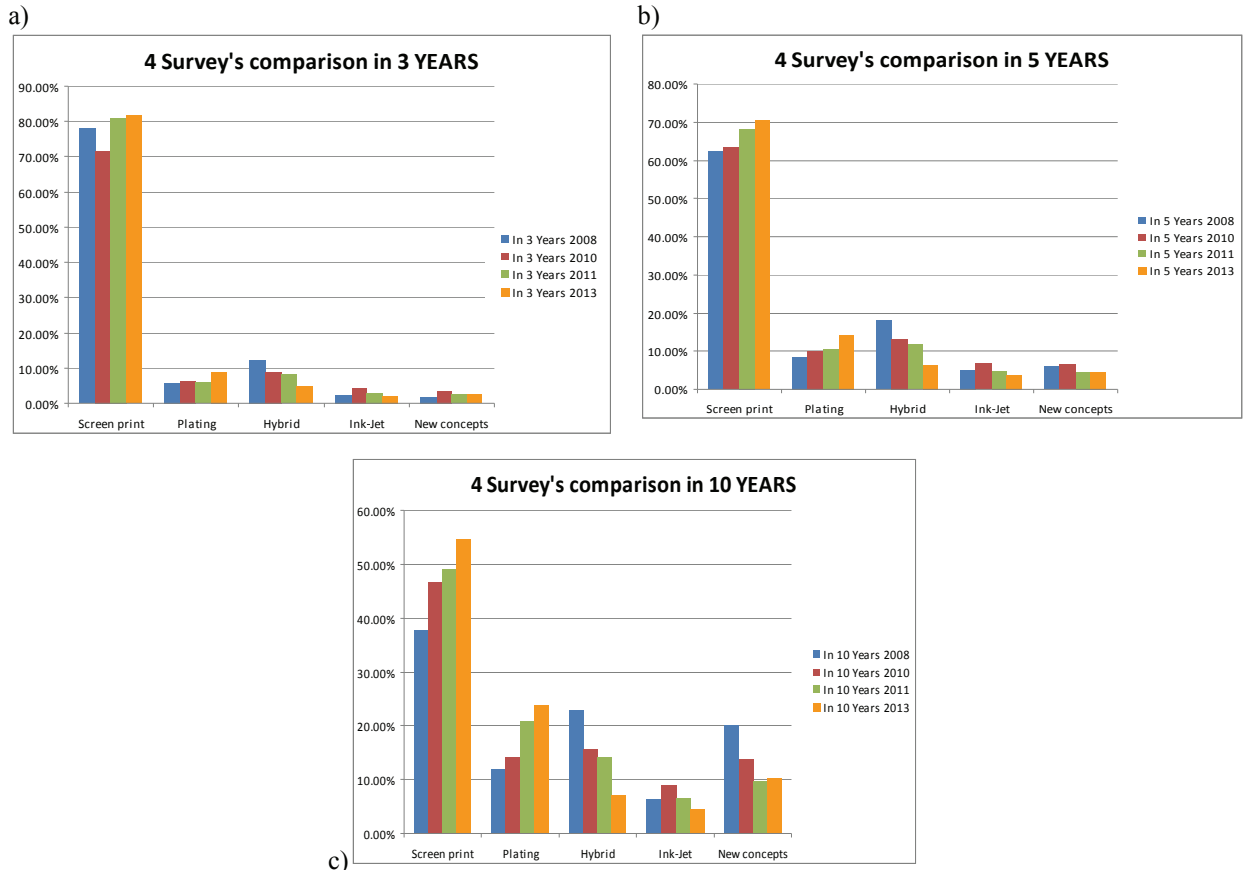


Figure 1: 2013 response to question: what kind of metallization will be used in 3, 5, and 10 years from now.

According to the participants in the coming 3 years from 2013 on screen printed metallization will slowly make place for alternatives, with most room for the full plating technology. After that this technology will become more successful in the years 5 and 10 from now. The hybrid approach (combination of thick film technology and plating) is not expected to play a big role in the coming years. Most remarkable is, however, that screen print technology will still be popular: in the eyes of the participants in 10 years screen printing will still be good for more than 50% of the production of crystalline silicon solar cells.

1.2. Comparison Surveys 2008 – 2010 – 2011-2013

In the following three graphs (figures 2, 3, and 4) the results from the three years have been put together to look into the future in 3, 5 and 10 years.



Figures 2a –c: surveys compilation of the four metallization workshops in 10/2008, 04/2010, 10/2011 and 05/ 2013

As stated already in 2011 the results again show a revival in interest in screen print. While in 2008 the hybrid approach as an alternative to screen print was popular, the 2011 response shows less confidence in the hybrid approach and bets on full plating for the future, also leaving other alternatives behind. This trend is also present in 2013, but the share of screen printing technology is expected to stay at a higher level than two years ago.

1.3. Comparison Surveys 2008 – 2010 – 2011 for approximately the same time in the future.

In the following graph (figure 3) the data are compiled such to look at approximately the same time in the future.

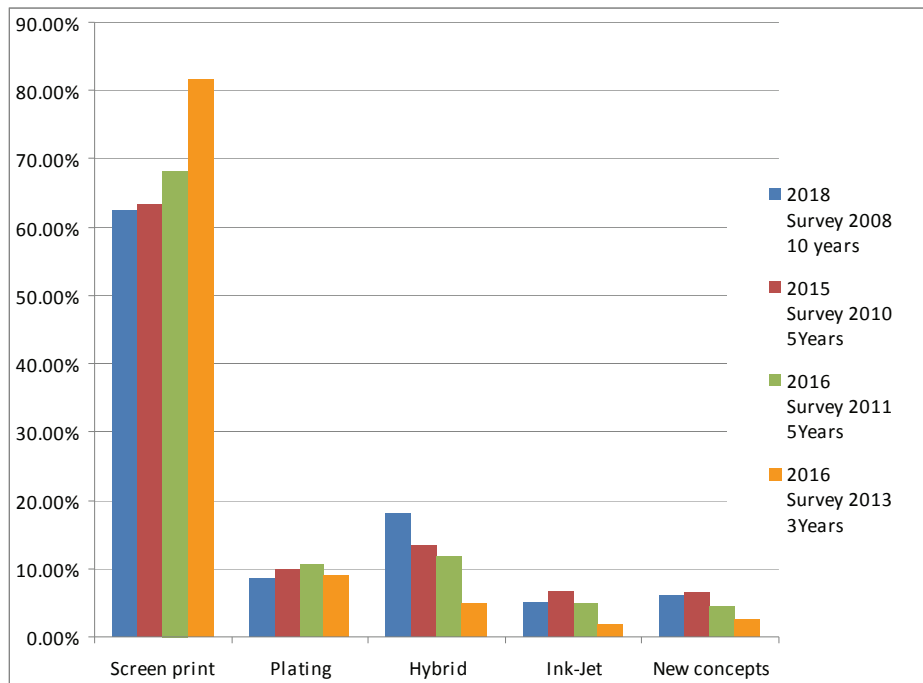


Figure 3: comparison of surveys in 2008, 2010, 2011 and 2013 for approximately the same time in the nearer future (2015/2016), i.e. 10 years from 2008, 5 years from 2010, 5 years from 2011 and 3 years from 2013

From the response of the experts the confidence in screen printing technology has sharply increased over the period 2008-2013, cranking up the share from 60% to 80%. The prediction for 2016 of the current workshop in 2013 gives a share from over 80% for screen printing technology compared to approximately 65% from the 5 years prediction of the workshop in 2011. The mix of the participants regarding their backgrounds has been rather the same over the three workshops. The hybrid approach had a significant projected share still in the 2008 survey, but the confidence in its share decreased rapidly with a sharp drop in the actual survey. Of course, the increase in interest in screen print decreases the shares of the alternative methods overall. However, the confidence in screen print can be attributed to the progress and improvements realized in the last years. The prediction for the share of plating technology for the same time in future stayed nearly the same over the years.

2. What in your opinion will be the percentage share of the metals used for front grid in solar cell production?

2.1. Results survey 2013

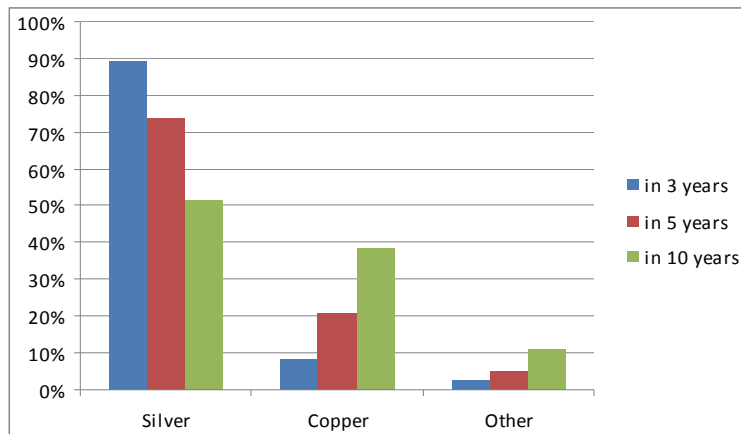


Figure 4: share of the metals used for front grid in solar cell production

The share of metals used for contact formation predicted to be used in future is consistent with the previous questions for the share of metallization technologies, with a steady decrease of silver consumption and increasing use of copper. However, the share of copper is higher whereas the share of silver is lower than the predicted use of the required technologies in ten years. This could be a hint that some experts expect copper based pastes for screen printing.

2.2. Share of metals used for front grid in solar cell production – break down by affiliation

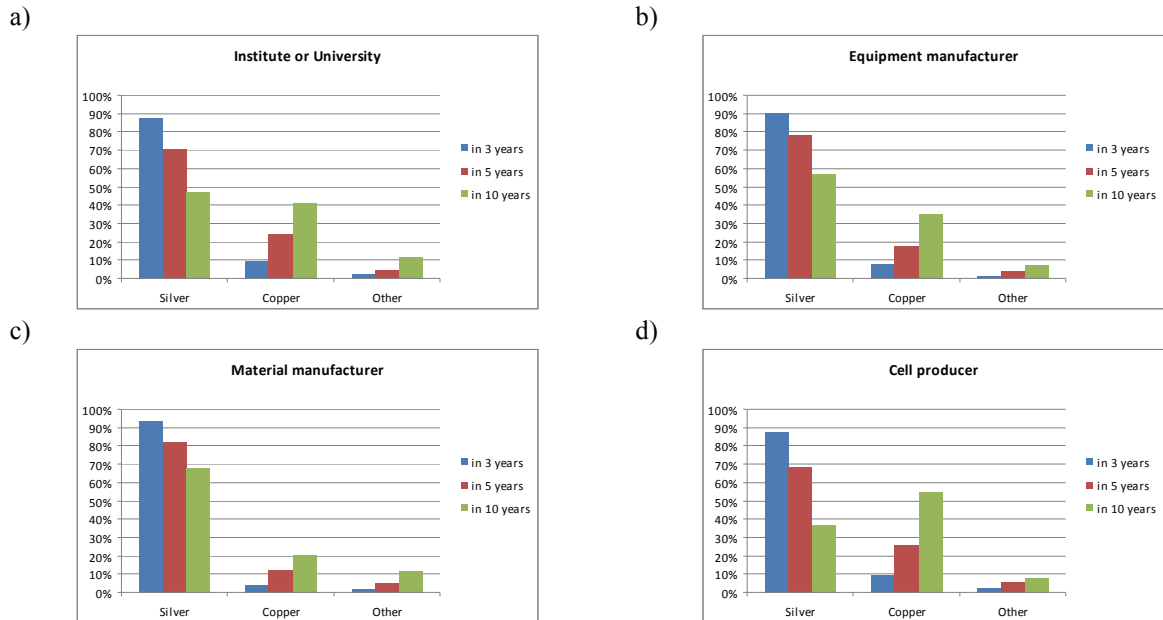


Figure 5 a – d: Share of metals used for front grid in solar cell production by affiliation. a) Institute or University, b) Equipment manufacturer, c) Material manufacturer, d) cell producer

The question “What in your opinion will be the percentage share of the metals used for front grid in solar cell production?” was further broken down per affiliation, and resulted in the final four graphs (figures 5 a- d). Cell producers tend to see the share of Cu plating in 10 years at more than 50%, whereas materials manufacturers seem the least optimistic for a fast introduction of Cu in cell manufacturing.