# Interdigitated Back-Contacted Heterojunction Solar Cells: A Quest for the Holy Grale?

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Even though the laboratory record for wafer based crystalline silicon solar cells has not been beaten since in 1997 Dr Zhang of UNSW reported a tiny (< 1 $cm^2$) 25% efficient `PERC' cell, other labs are rapidly catching up with much larger area cells. This year Panasonic reported a laboratory cell efficiency of 24.7% for their 102 $cm^2$ heterojunction (HIT) solar cell structure and in 2013 SunPower reported 24.2% on one of their full scale interdigitated back contact (IBC) homojunction cells from one of their factories. It is not surprising that the highest cell efficiency values come from industry these days. The progress in cell efficiency in industry has been impressive in the past 15 years. In 1997, the best commercial module efficiency was only ~13%, SunPower produces >21% solar modules.

In 2011, HZB in Berlin reported the first high efficiency results >20% for a concept combining the strengths of the IBC and HIT concepts: the IBC-HJ concept, which is a back-contacted solar cell in which the IBC structure on the rear is formed by patterned a-Si:H layers, therewith forming local heterojunctions. Industry labs followed this trend rapidly: a few months later 23.4% was demonstrated by LG (4 $cm^2$), Sharp reported 24.2% a few months ago for this concept(also small size). Based on simulations, the concept should be able to reach conversion efficiencies over 25% when performed perfectly.

Since 2012, development of the IBC-HJ process is also being performed at ECN Solar with an industrially compatible IBC-HJ process on large wafer size as its aim. With a best efficiency of 9.5% on 4 x 4 $cm^2$ it is clear that, at this moment, there is still some way to go. Besides all the advantages of the IBC and HIT concepts, challenges like high resolution patterning of amorphous silicon layers without using non-industrial methods such as photolithography (as LG and Sharp did) need to be overcome to introduce the concept into industry. With very high efficiencies of the competing industrial technologies, the biggest challenge is to be able to reach equal or higher efficiencies at lower or equal cost. To reach this goal, a thorough understanding of the concept and processes is essential.

At QUANTSOL we can present an overview of the day-to-day challenges that are encountered in developing IBC-HJ and the way we are solving them by experiments, modeling and our collaboration with Dutch partners. Also related subjects that we have worked on, such as ideas for module interconnection of IBC-HJ cells and non-amorphous silicon based heterojunctions on crystalline silicon wafers, will be addressed.