

Industry Outlook of Crystalline Silicon Solar Cells and Modules

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In the past 20 years or more, crystalline silicon solar cell has slowly but continually evolved in the form the standard p-type full Al-BSF, but in general industry adoption typically focuses in one mainstream technology and cell structure, where even process flow and choice of tools are relatively few. The notable variation is the wafer types itself, mono- or multi-crystalline Si wafers. However, in the last 8 years or so, in the dawn of p-type PERC, technology start to evolve a bit more rapidly and choice of passivating materials start to fracture into different types, different layers and even different types of equipment to deposit them. The choices of such layers and tools are the focus of the first part of this talk. With the demand of high efficiency cell and therefore high quality materials, multicrystalline silicon wafer as substrate has unexpectedly and rapidly became out-of-fashion to be replaced almost completely with monocrystalline wafer.

The arrival of n-type cell technology in the industry brought about even more variations, down to two (or three) main choices of device structures, Hetero-Junction cell (HJT), Tunnel-Oxide Passivated Contact (TopCon) cell and Interdigitated Back Contact cell. HJT and Topcon are currently on the race to be the dominant technology for n-type. TopCon cell are relatively new compared to HJT but has made very rapid progress, with various ways to grow the tunnel-oxide and its subsequent poly-Si layer which leads to many different process flows as of now. The pros and cons of HJT vs TopCon and the various ways to do TopCon cell structure will be the second topic of this talk.

Lastly, while in the past main focus on research seemed to be on cell efficiency, in the last 5 years, module technology has brought about many advancements to contribute in the massive increase in module power. From more advance materials, different stringing method, or even different module technology altogether has been developed. The evolution of module technology and its various application and potential will be discussed in the last part of this talk.