Area 1 Crystalline and Thin Film Silicon PV

PERFORMANCE OF DIAMOND SAWING MULTI-CRYSTALLINE SILICON WAFER AND CELL

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Photovoltaic (PV) technology is one of the main environment-friendly solutions to global energy issues, and more than 90% solar cells are made of single- or multi-crystalline silicon wafers. Nowadays, it is proved that the fixed abrasive diamond wire (DW) saw is more popular in silicon wafer manufacture fab because of its potential for 2-3 times higher productivity, less silicon kerf loss compared with the multi-wire saw based on SiC-slurry-wire system, less wafer surface damage and lower pollution. DW technology is also regarded as a green and environmental-friendly slicing technology and will lead a revolutionary change in PV industry.

With much thinner damage layer on the wafer surface, DW mc-silicon wafer provides a better p-n diode base and will give a higher open current voltage (Voc.) for solar cells. But, thinner damage layer do little help to form an ideal texture structure on the mc-silicon wafer surface in traditional HNO_3-HF texture solution. It is also reported that there are several ways leading to modify the texture structure of DW mc-silicon wafers.

In our work, three texture methods were involved to modify the texture structure of DW mc-silicon wafers, which involved modified HNO_3-HF system by addition agent (ADD) into traditional HNO_3-HF texture system, porous silicon (Porous), and reactive-ion etching (RIE) texture technology. Surface microstructure, surface reflectivity and light-trapping performance of the three textured DW mc-silicon wafers were studied and investigated. Characterization of solar cells performance fabricated by the three textured DW mc-silicon wafers were discussed.

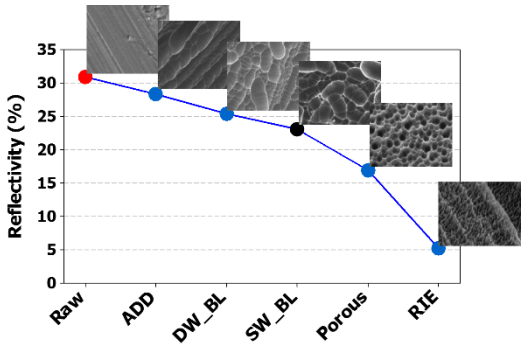

Fig.1 Reflectivity of raw and textured DW mc-silicon wafers

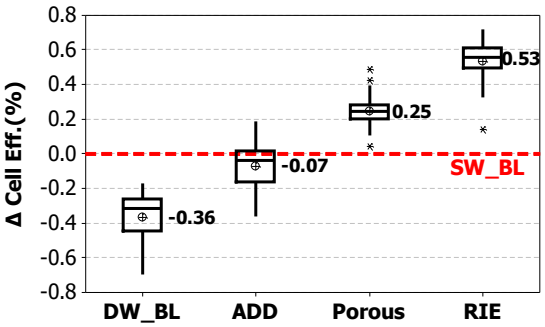

Fig.2 Cell performance of several textured DW mc-silicon wafers

In the experiment, silicon wafers sliced by a SiC-slurry-wire system and textured by traditional HNO_3-HF solution were used as the samples of baseline fabricated solar cells, named as SW_BL in Fig. 1 and Fig. 2. While, DW_BL samples were DW mc-silicon wafers textured by traditional HNO_3-HF solution.

In is found that the ADD agent can help to adjust the reaction speed and the anisotropic etching factor of the different mc-silicon grains and to form some small cores for worm-like texture structure on silicon wafer surface. However, the wafers still have higher reflectivity, and their cells have lower cell efficiency. Moreover, the texture with the ADD agent can't form a uniform texture structure on the DW mc-silicon wafer surface, which will cause grain color issue in mc-silicon solar cell productions.

It is concluded that porous and RIE methods are more suitable to texture DW mc-silicon wafers, because porous and RIE silicon wafer have much uniform and smaller texture structure than silicon wafers textured with the ADD agent. The reflectivity of porous and RIE silicon wafers is much lower than that of baseline silicon wafers, because their nano-structured wafer surface has much better light-trapping properties, which can solve color issue and give better cell performance in mc-silicon solar cells.

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