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# EFFECT OF REAR-SIDE SURFACE MORPHOLOGY ON THE PERFORMANCE FOR PERC SOLAR CELL

## Abstract:

Rear-side passivated solar cell is one of the next-generation concepts for industrial mass production lines. The most suitable candidate for P-type silicon rear-side passivation is aluminum oxide (Al2O3) due to its excellent field effect passivation effect than any other dielectric material. Reduction of surface recombination mainly leads to an improvement of open-circuit voltage (Voc), yielding a higher conversion efficiency. In this study we investigate two kinds of rear-side surface morphologies: polished surface (with 3~6 μm etch depth) and fully textured pyramids, where the Al2O3 thin films deposit using self-developed non-vacuum spatial atomic layer deposition system. The polished surface is obtained after further etching the pyramid structures, needing a 6 vol % KOH solution at 80°C for about 3.5 min. Although further polishing process may enhance the cost of production, it is necessary to proceed the step for achieving better performance of PERC cells. Various surface morphologies have been compared in terms of surface recombination velocity, contact resistance and optical performance, having impacts on Voc, fill factor (FF), and short-circuit current (Jsc), respectively. The experimental results show that the surface with less roughness allows Al2O3 thin films to be deposited well. The rear surface recombination velocity is strongly reduced for flattened surfaces attributed to changes in crystal orientation and reduced surface area, leading to higher value of Voc. In contrast, the coverage of Al2O3 thin films on textured surface may probably be damaged at the peak and valley areas, thus the worse Voc is obtained. A polished rear surface, looking like a mirror, reflects more long-wavelength incident light at the range of 700 to 1200 nm than the amount that the textured surface reflects. This is likely due to the reduction of light scattering or absorption from particles or defects existing before polishing process. The discrepancy in reflection can be clearly proved by internal quantum efficiency. More trapped light excite more photogenerated carriers to be collected, enhancing the value of Jsc. The rear-side textured sample has slightly lower FF than that of the sample with polished surface. It can be explained that worse coverage of passivation layer and metal contact lead to higher reverse saturation current and contact resistance, respectively. Besides, effects of various rear-side morphologies on the formation of Al-Si alloy, which may influence the electrical performance of cells are investigated. Finally, the PERC cell with polished surface has a better conversion efficiency of 19.15 %.

## Keywords:

surface morphology, self-developed non-vacuum spatial atomic layer deposition, long-wavelength

light

**JEL Classification:** Q40, Q20