

Investigations on Additives for Batch Cluster Processing for Industrial TOPCon Solar Cells

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Abstract

Industrial Perovskite-Silicon tandem solar cells require a cheap and efficient Si bottom cell. This paper focuses on the Si bottom cell. Tunnel Oxide Passivated Contacts (TOPCon) solar cells are the next industrially relevant cell concept after the Passivated Emitter Rear Contact (PERC) concept. TOPCon cells require a poly-Si film on the backside, which is also deposited on the sides and on the front of the cell. The parasitic deposition at the edges and front side needs to be removed in order to guarantee a safe module performance. This is done using wet-chemical etching steps. First, the phosphorous-doped Si glass (PSG) on the poly-Si, formed during the exSitu doping of poly-Si, is removed from the front and the sides of the wafer in a single side inline HF wet process step. Next, the exposed poly-Si film is removed in a KOH batch process. Here, the 15 to 30 nm thin PSG layer on the rear side acts as a masking layer to protect the poly-Si layer underneath. This is only possible by using an additive, which enhances the Si/SiO₂ etch rate selectivity in KOH in order to maintain the PSG acting as a masking layer. This additive is the main driving parameter of the running cost for chemical edge isolation and poly wrap around removal step and hence an important factor for the CoO for TOPCon cells manufacturing. This work focuses on such additives. A newly developed additive is compared to a market additive in terms of Si/SiO₂ etch rate selectivity, Si etch rates, and Si surface morphology after polishing. It is shown that etch rate selectivity and Si polishing grade are sufficient for both additives, whereas the newly developed additive shows a 20% increased Si etch rate. This is beneficial because the increased Si etch rate allows lower process time and KOH usage, resulting in lower costs, higher throughput, and less water consumption.

Keywords

Silicon Solar Cell, TOPcon Cluster, Additive, PSG, Wet Processing, Industrial, Si Bottom Cell