

Wafer Surface Preparation for High-Efficiency Solar Cells

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ABSTRACT

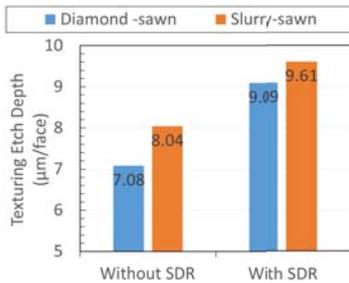
For the fabrication of high efficiency heterojunction (HIT) solar cells, wafer surface preparation by advanced wet chemical processes is critical in assuring surface qualities for high cell performance

EXPERIMENTAL

- 156mm PSQ n-type mono-Si wafers processed with fully automated GAMA Solar™ wet station
- Wet Process Flow: Pre-clean → KOH/IPA Texturization → Pyramid-Rounding and Post-clean → Dry ; i.e. best known method (BKM)
- Different PECVD splits were also conducted on some BKM wafers to develop optimum process conditions
- Experimental Splits on Wafer Surface Preparation:
 - BKM (best known method)
 - BKM + enh-R (BKM with enhanced pyramid-rounding)
 - BKM + enh-C (BKM with enhanced post-cleaning)
 - BKM + enh-R&C (BKM with enhanced rounding and cleaning)
 - SDR + BKM (SDR followed by BKM)
 - SDR + gettering + BKM (SDR followed by metal gettering and then BKM)

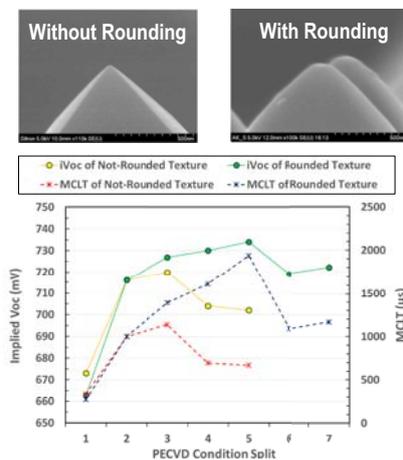
RESULTS AND DISCUSSION

Effect of SDR on Texturing Etch



- Without SDR, diamond-sawn wafers show noticeably slower texturing etch rates than slurry-sawn wafers
- Adding a separate SDR step reduces the difference in Si loss between the diamond- and slurry-sawn wafers

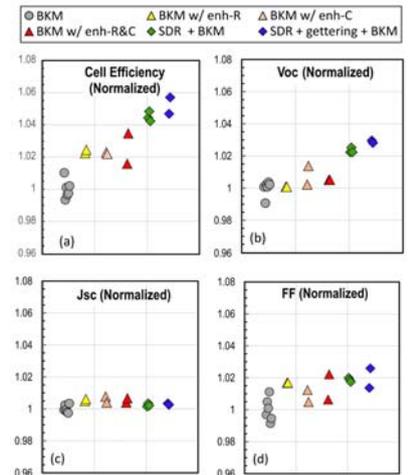
Effect of Pyramid Rounding



- Akrion's proprietary rounding step smoothens the peak of pyramids
- Wafers with the rounding treatment show improvements in Voc and MCLT
- The optimal PECVD condition can be dependent on the extent of texture rounding

Effects of Enhanced Clean vs SDR / Metal Gettering

Process	Efficiency Improvement vs. BKM
BKM w/ enh-R or enh-C	2.2 rel%
BKM w/ enh-R&C	2.5 rel%
SDR prior to BKM	4.5 rel%
SDR plus metal gettering prior to BKM	5.2 rel%



- Since the change in Jsc and FF by the additional surface conditioning is marginal, the efficiency improvement can mostly be attributed to the relatively significant increase of Voc
- The results indicate the importance of high degree surface metal removal and bulk metal reduction to increase Voc and, in turn, cell efficiency

CONCLUSIONS

- The quality of wafer surfaces plays a key role in the texturing etch characteristics of Si wafers
- Pre-cleaning and SDR steps are recommended to normalize the surface of different wafers prior to the texturization process
- Final cleaning processes with appropriate pyramid rounding further enhance the cell performance
- Lowering metal signature on the surface and/or in the bulk is beneficial for higher Voc and thus cell efficiency
- Advanced wafer surface preparation integrated with optimized PECVD steps and subsequent flows leads to great improvement of cell performance