Small Pyramids for Light-Trapping in Silicon-based Heterojunction Solar Cells

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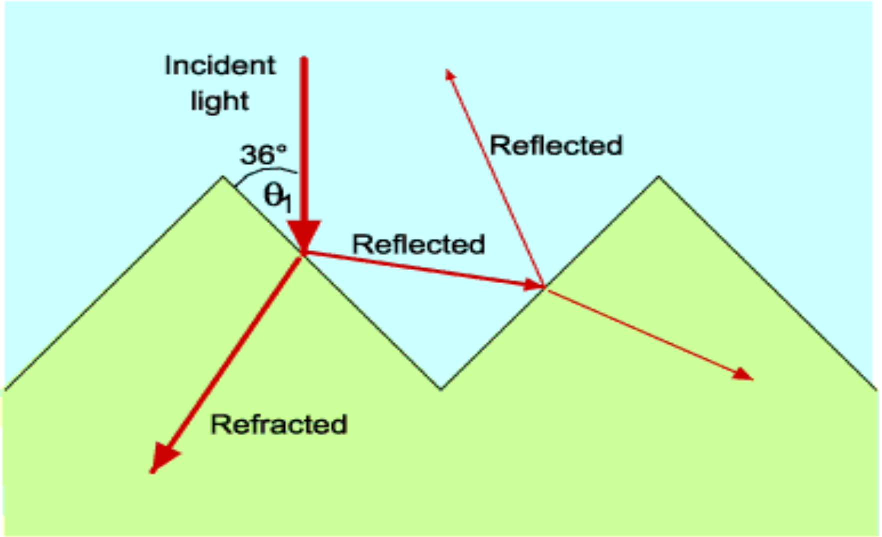
What We Attempted to Solve

Our main goal was to decrease the surface recombination by reducing the size of our pyramid textures while maintaining similar reflectivity.

Texturing is done through anisotropic etching in a corrosive KOH bath. Through altering this process, we were able to affect the size of the pyramid textures.

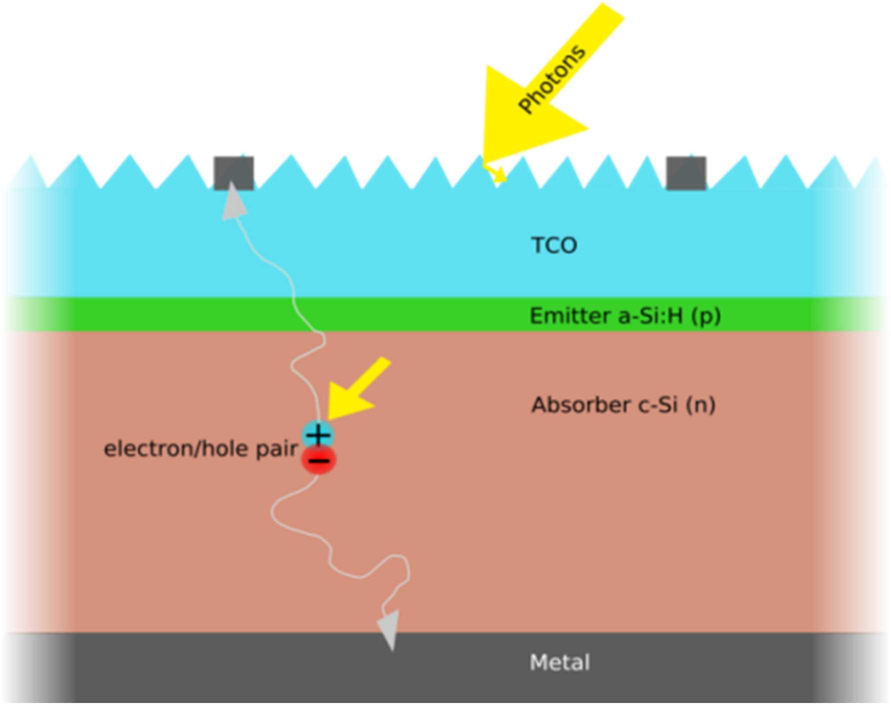
Although smaller pyramids theoretically trap less light, we hoped that the reduced surface area limits surface recombination which would ultimately increase efficiency.



Light Trapping. Pveducation.org

How we Approached this Project

1. Altered the duration of both the Saw Damage Removal bath and texturing bath, and the amount of additive in the texturing bath.
2. Determined how these changes to the wet processing procedure affected pyramid size through SEM.
3. Determined the reflectivity according to pyramid size.
4. Passivated the surface with deposition of amorphous silicon.
5. Determined the minority carrier lifetime.



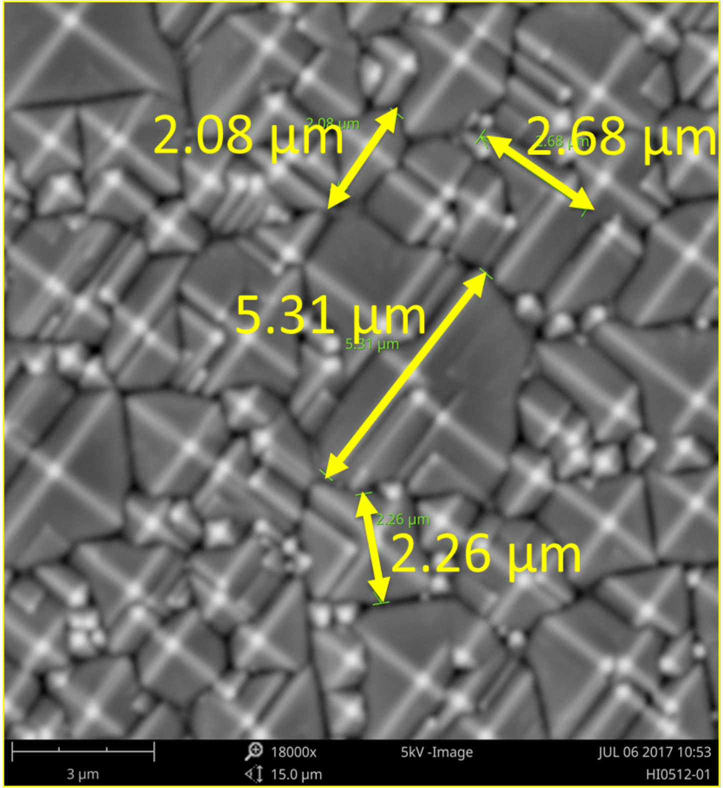
Modeling of Electronic Properties of Interfaces in Solar Cells

How we Approached this Project

Texturing Conditions	Texturing solution composition at 80 °C	SDR Time (minutes)	Texturing Time (minutes)	Pyramid Size (µm)	Reflectance(%) @ 630nm
1	50 mL GP Solar + 800 ml KOH+17 liters DI water	7	25	2µm - 5µm	8.01%
2	200 mL GP Solar + 800 ml KOH+17 liters DI water	7	10	1µm – 1.75µm	8.36%
3	200 ml GP Solar+800 ml KOH+17 Liters DI water	10	10	700nm – 1µm	8.15%
4	200 ml GP solar + 800 ml KOH+ 17 liters DI water	12	10	1µm – 1.25µm	8.08%

- Condition 1 is the current baseline procedure at ASU Solar Power Lab.
- All these wafers were processed in a single lot.
- We increased the amount of additive, increased SDR time and decreased texturing time.

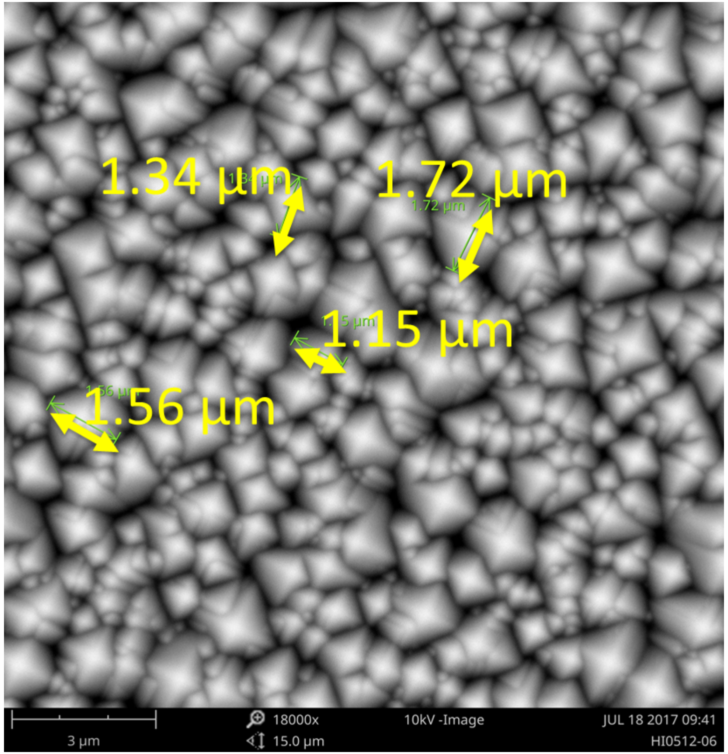
Results & Analysis



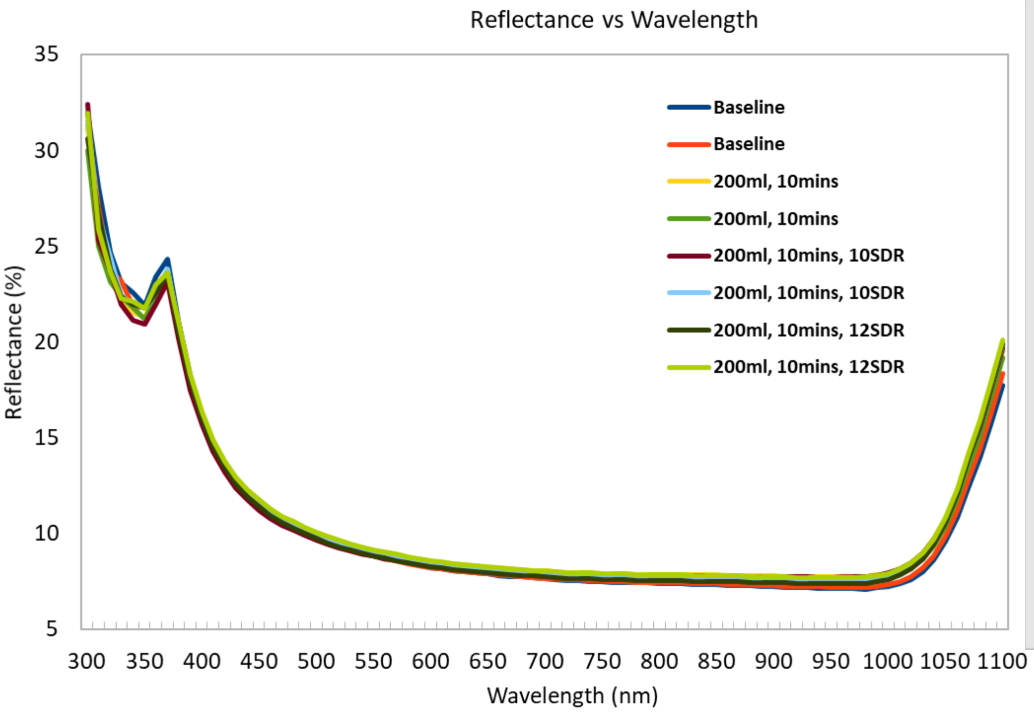
Lot: HI0512

Left: Baseline (Condition 1)

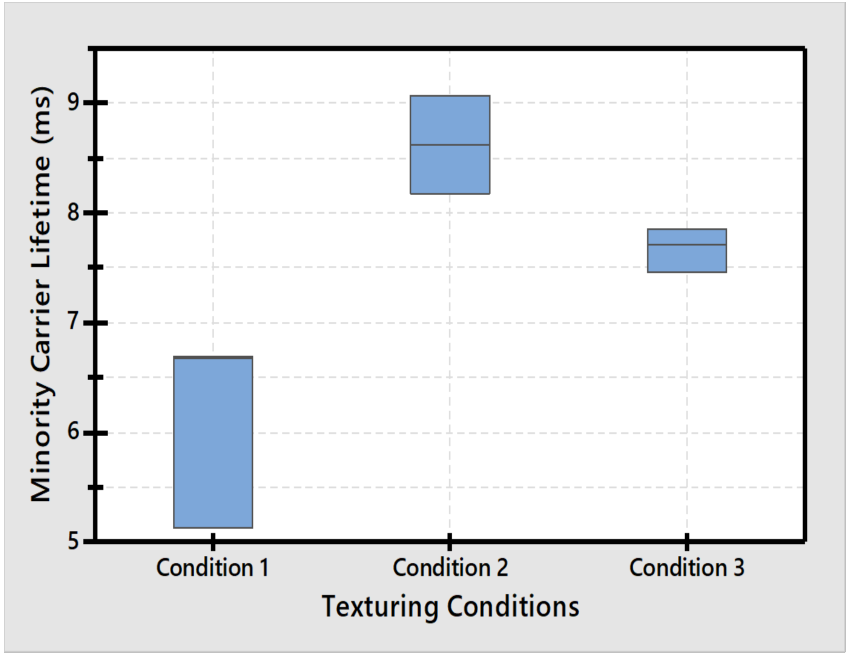
Right: 200 ml, 10 min (Condition 2)



Results & Analysis



Reflectance comparing different texturing solutions



Lifetime for the different Conditions

Conclusion & Further Work

- We were able to achieve uniform pyramid textures ~ 1 um in size by altering the chemical composition and duration of process.
- These pyramids absorbed light as efficiently as larger pyramids.
- In addition, the MC lifetimes of small pyramid samples were significantly higher in comparison to their larger pyramid counterparts.
- However, we still need to make completed solar cells using this procedure to ensure our results hold up.

Thank you for listening to our Presentation.

Do you have any questions?