

Silicon Solar Cells with Front Hetero-contact and Aluminum Alloy Back Junction

Hao-Chih Yuan, Matthew R. Page, Eugene Iwaniczko, Yueqin Xu, Lorenzo Roybal, Qi Wang, Howard M. Branz, and Daniel L. Meier*

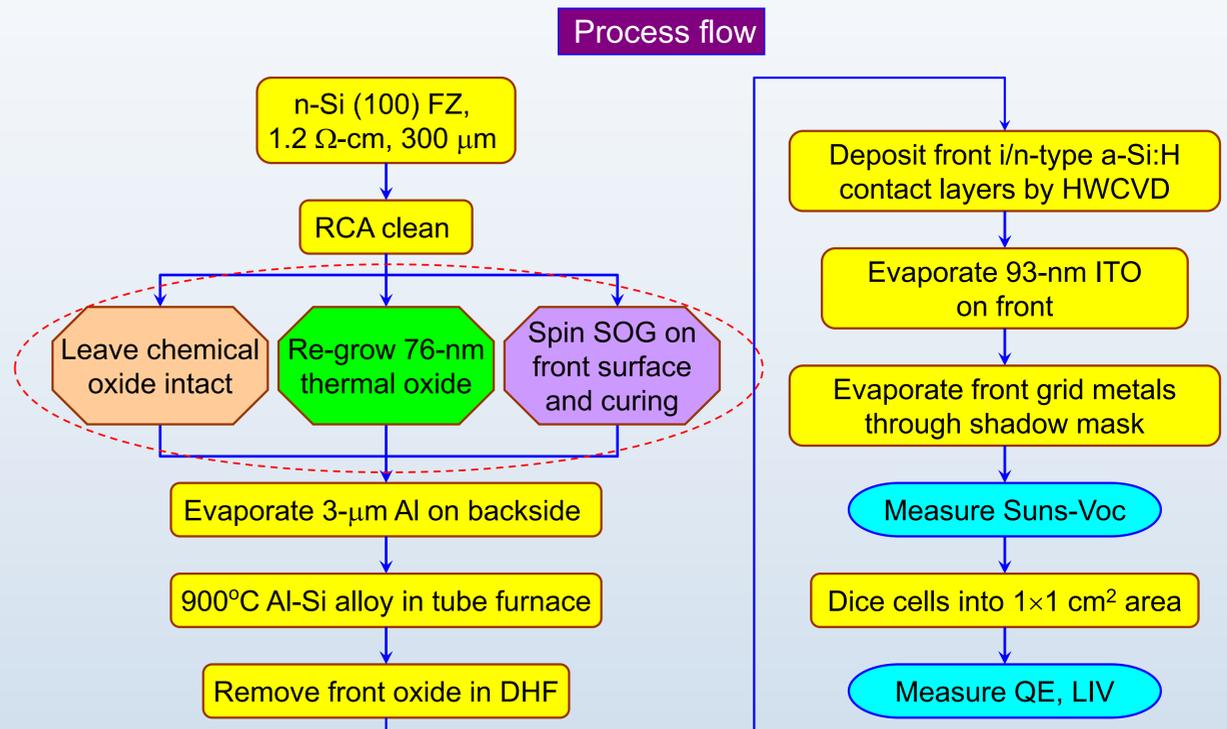
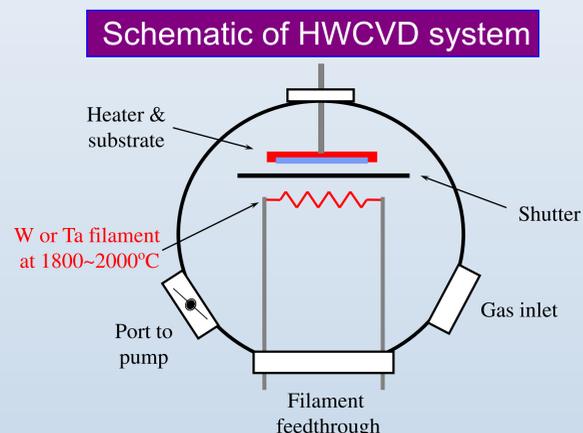
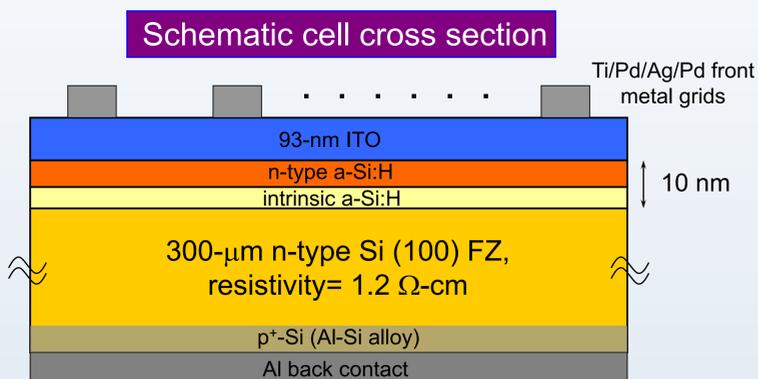
National Renewable Energy Laboratory • Golden, CO 80401

* Present address: Suniva Inc. • Atlanta, GA 30308

I. Objective:

- To apply industrial back Al process in efficient n-wafer cells
 - with a-Si:H front surface passivation
- To evaluate the surface recombination velocity (SRV) of the a-Si:H passivated front surface with different surface preparation procedures

II. Experiment:

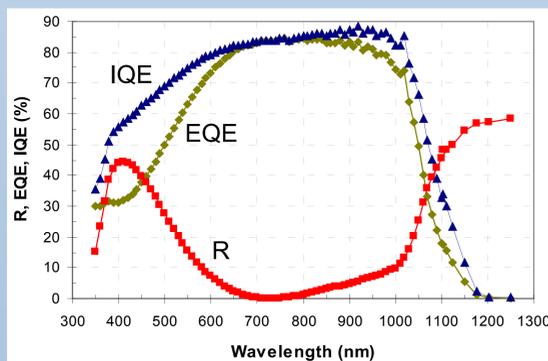


Three surface preparation procedures were studied to evaluate the effectiveness of preserving the clean Si surface until a-Si:H deposition.

III. Results:

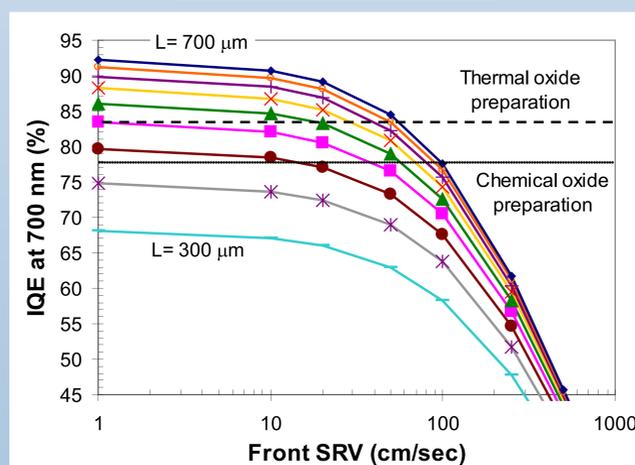
Summary of Suns- V_{oc} and IQE

Front surface preparation	Leave chemical oxide intact	Re-grow 76-nm thermal oxide	SOG on front
Suns- V_{oc} (mV)	611	617	548
IQE at 700 nm (%)	77.7	83.4	—



- Thermal oxide is most effective for preserving the cleanliness of the c-Si surface through the high-temperature Al-Si alloying.

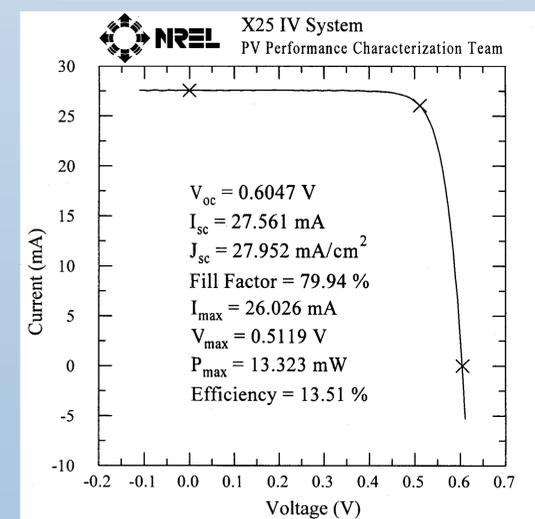
PC1D simulated IQE



Simulation suggests finished cells have

- diffusion length better than 450 μm
- front SRV of thermal oxide prepared surface between 10-50 cm/s
- front SRV of chemical oxide prepared surface twice as high

Certified IV on present status



- V_{oc} = 604.7 mV
- J_{sc} = 27.9 mA/cm²
- FF = 79.9%
- η = 13.5%

IV. Summary:

- An alternative cell structure that incorporates front a-Si:H hetero-contact and Al-Si alloy back junction is demonstrated for the first time.
- Thermal oxide effectively preserves the cleanliness of the c-Si through the high-temperature Al-Si alloying for a-Si:H passivation.
- Front SRV of the a-Si:H passivated surface prepared by thermal oxide is between 10-50 cm/s and is close to that on SHJ cell fabricated at low temperature.
- 13.5% conversion efficiency is demonstrated on planar cell with single-layer anti-reflection coating.