National Renewable Energy Laboratory
Innovation for Our Energy Future

Crystal Silicon Heterojunction Solar Cells by Hot-wire CVD

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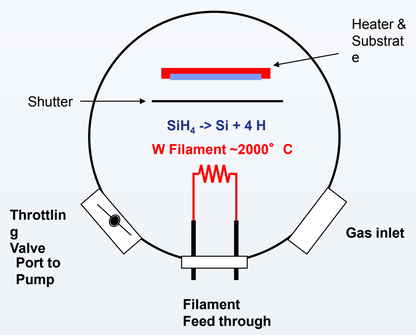
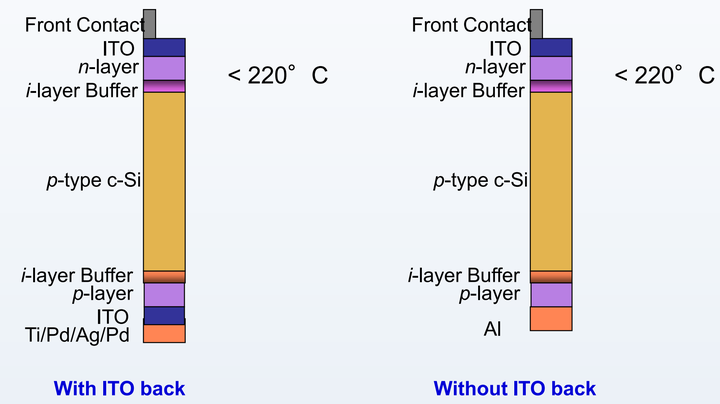
Hot-wire CVD System



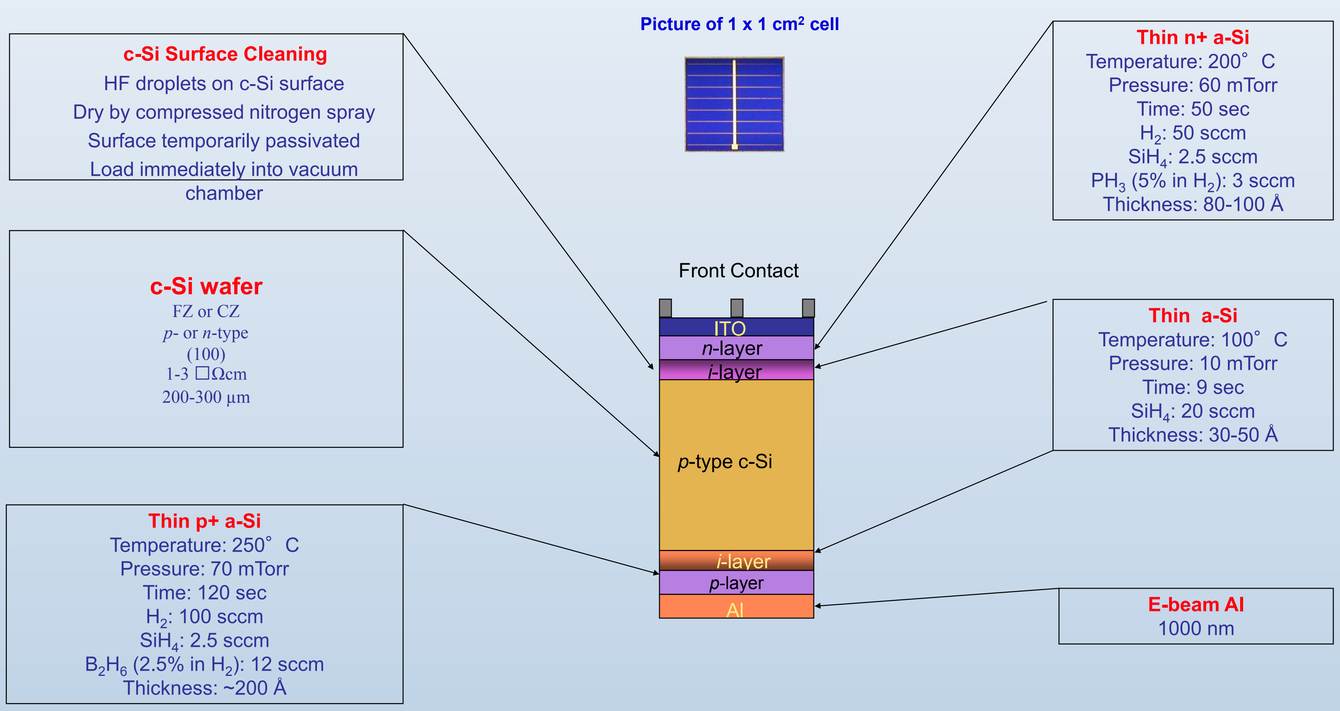
Advantage of HWCVD

- Simple deposition system
- Fast deposition rate
  - –10 Å/s i a-Si:H
- In-situ atomic H treatment
- No plasma instability
- No plasma damage to silicon surface

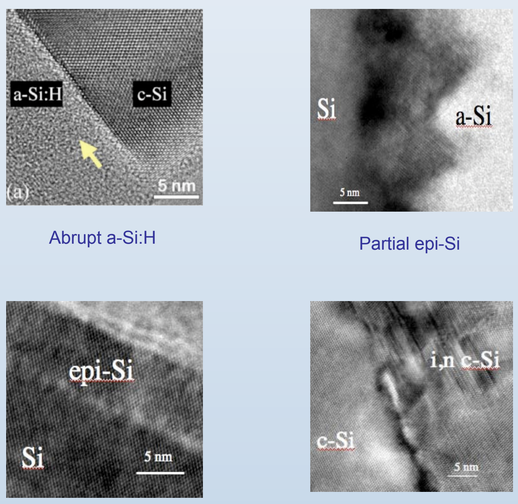
Fast and Low Temperature Emitter



Emitter and Back Contact Process



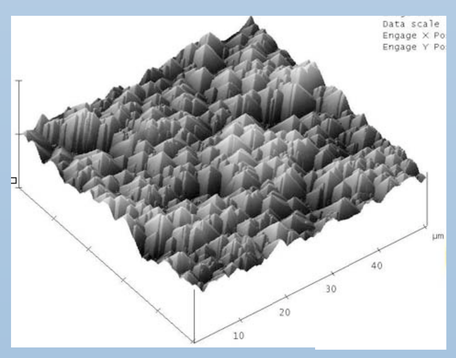
a-Si/c-Si interface

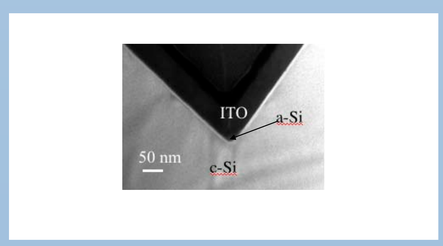


Abrupt a-Si:H — Partial epi-Si — Full epi-Si — Poor epi-Si

Solar Cell Performance

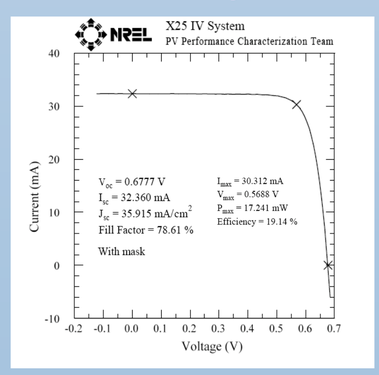
Textured Surface

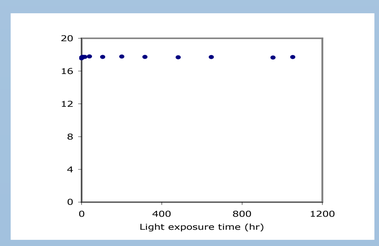




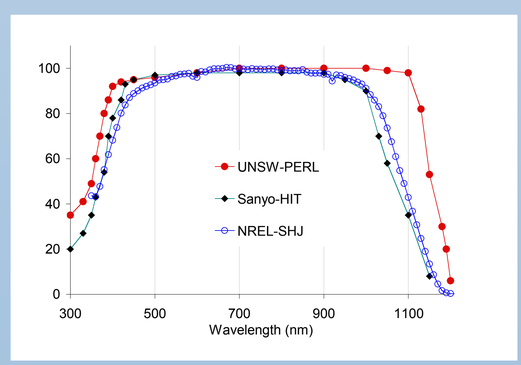
JV Measurement

Efficiency 19.1%





Internal QE Measurement



SHJ needs further increase in red response

Summary

- **19.1%** on FZ, 18.7% on CZ *p*-type c-Si
- SHJ cell by low temperature (< 200° C) HWCVD
- Double-sided SHJ yields a high V_{oc}
  - **689 mV** on *p*-type FZ c-Si
  - **694 mV** on *n*-type CZ c-Si
- HWCVD can be alternative to standard PECVD!
  - -Wide process window for i-layer
  - -High deposition rate

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Presented at the 33rd IEEE Photovoltaic Specialists Conference • San Diego, CA • May 11–16, 2008 • NREL/PO-520-43315