Passivated Emitter Rear Polysilicon (PERPoly) solar cells and beyond

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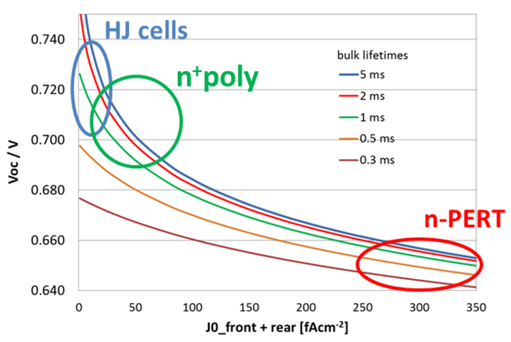
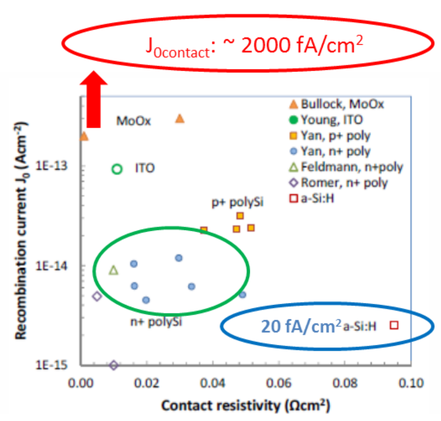
Carrier selective and passivating contacts

- Metal contact recombination dominates n-PERT, PERC, Al BSF cells
- Selective contacts: screen minority carriers from metal and enable transport of majority carriers

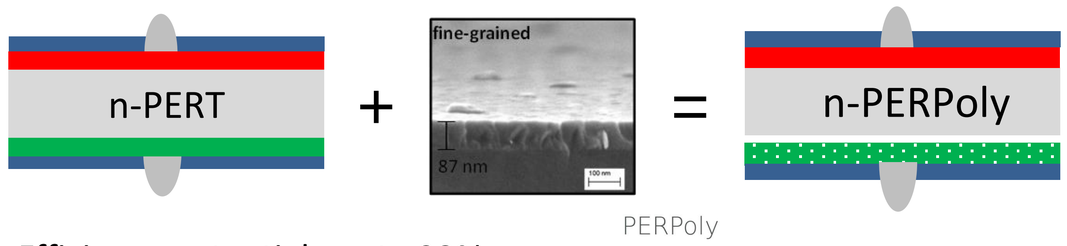




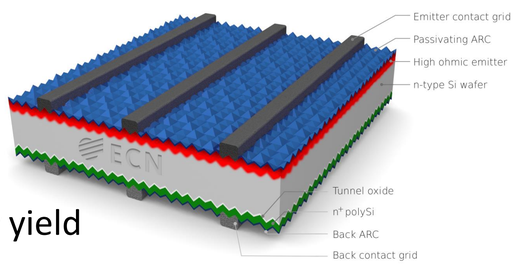
Cells with poly-Si: J_0 n^+poly-Si almost as low as a-Si
Stable at high temperatures → screen print + fire possible
Lower contact resistivity and lower absorption → higher FF and J_{sc}

ECNs vision: Industrial carrier selective contact cell

- n-PERT + n^+poly-Si rear → **PERPoly** cell

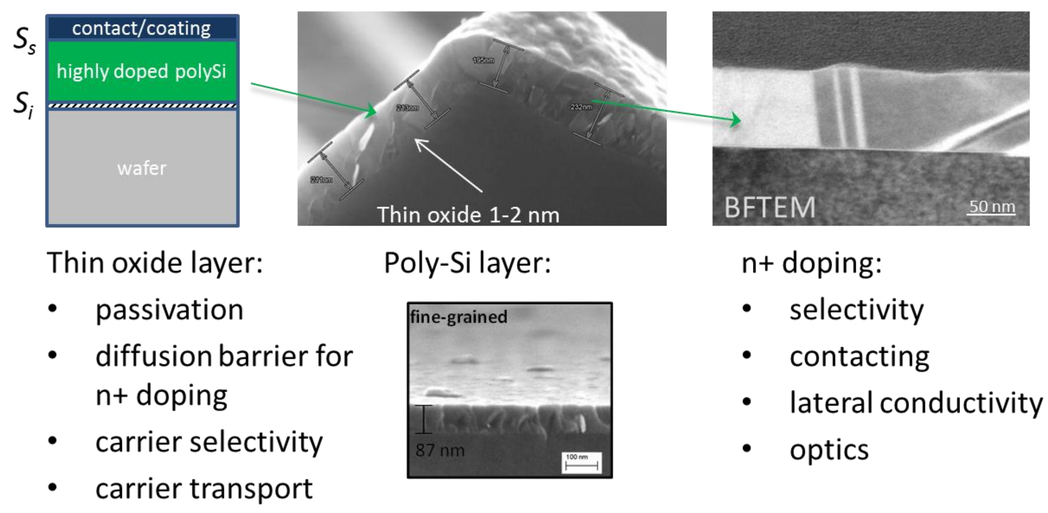


- Efficiency potential: up to 23%
- 6 inch Cz material
- Print + fire through contacts
- Industrial , high throughput tools
- Bifacial solar cell → additional energy yield



Oxide and poly-Si layers

Broad process window for high V_{oc} values
J_{sc} and FF optimized by poly thickness, doping level and n+ profile



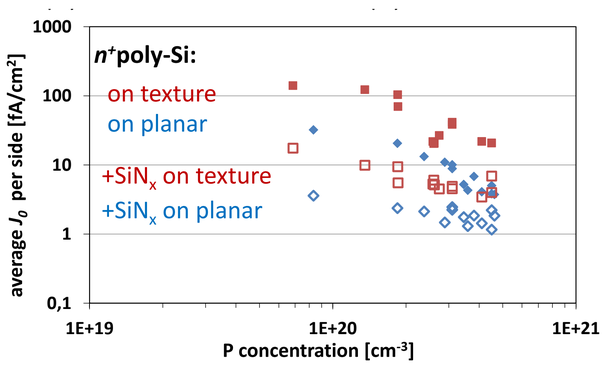
Thin oxide layer:
- passivation
- diffusion barrier for n+ doping
- carrier selectivity
- carrier transport

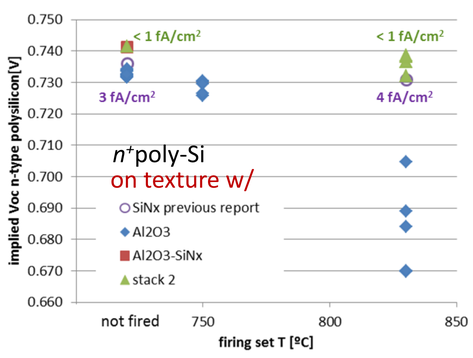
Poly-Si layer:

n+ doping:
- selectivity
- contacting
- lateral conductivity
- optics

n^+poly-Si passivation properties

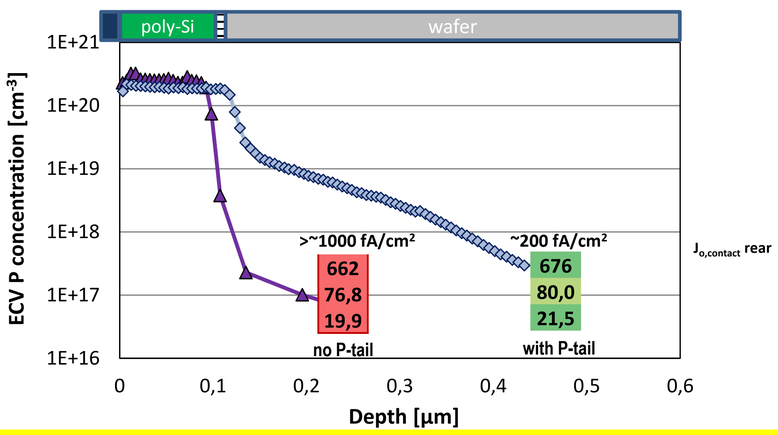
- J_0 improves with higher doping concentration (field-effect passivation ↑)
- Hydrogenation of interface defects reduces J_0 (chemical passivation ↑)
- Excellent and stable passivation on both planar and texture (<1 fA/cm²)





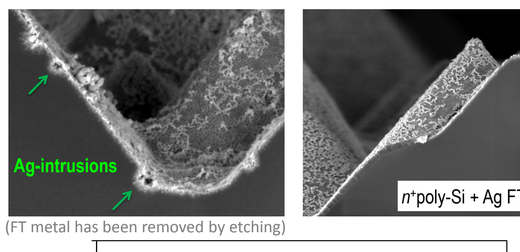
Influence of n^+poly-Si/SiO_x properties on PERPoly cells

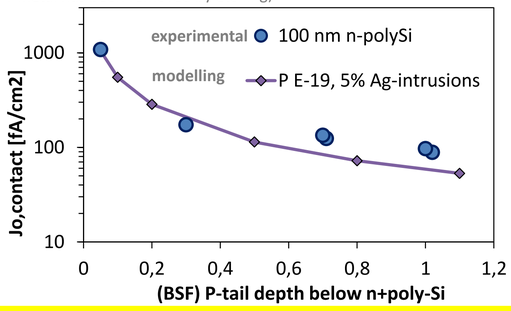
- Doping level at Ox./c-Si is not critical for high FF
  but the <u>effective charge carrier mobility</u> of the thin oxide
- <u>Presence of a moderate P-tail</u> is critical for low $J_{o,contact}$
  with industrial Fire-Through metallization

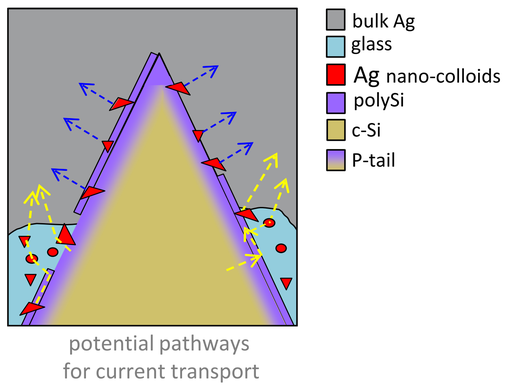


n^+poly-Si with Fire-Through (FT) metallization

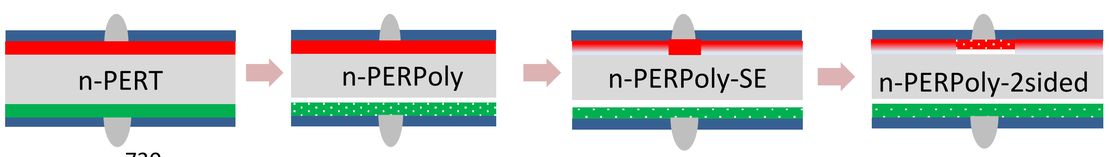
- Under FT paste, large areas where poly layer is removed
- P-tail below n-polySi reduces $J_{o,contact}$ down to 100-200 fA/cm²

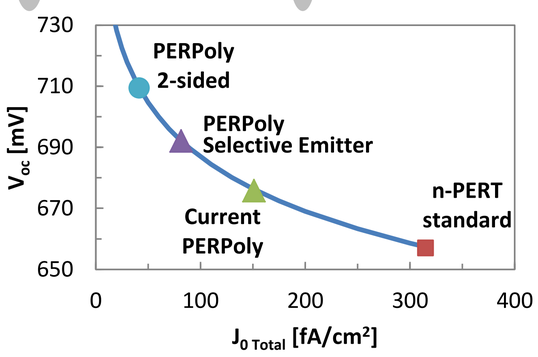




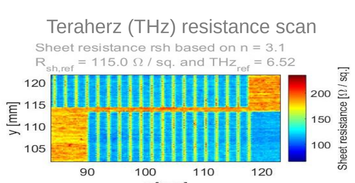


Towards cell with all industrial passivating contacts





Latest results
Prior metallization
iVoc 705 mV (40 fA/cm²)



ECN PERPoly roadmap to 23%