POLY-IBC ARCHITECTURE

IBC cell architecture with passivating contacts for highest performance

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ECN TNO innovation for life

THE IMPORTANCE OF EFFICIENCY

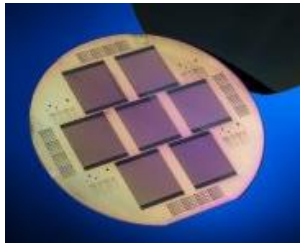
Limited space
→ highest energy yield

Balance of System cost: per area
→ Less cost per unit energy

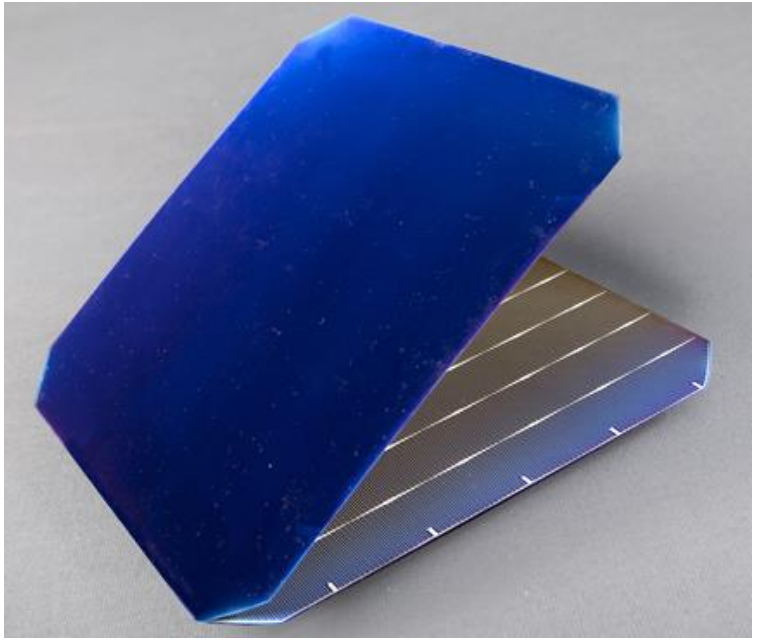
Source: SEAC

IBC CELLS

- Free of metal on the front side → highest current
- Can be simple processing
  → industrial piloting of TNO diffused “Mercury” IBC
- High lab efficiencies demonstrated

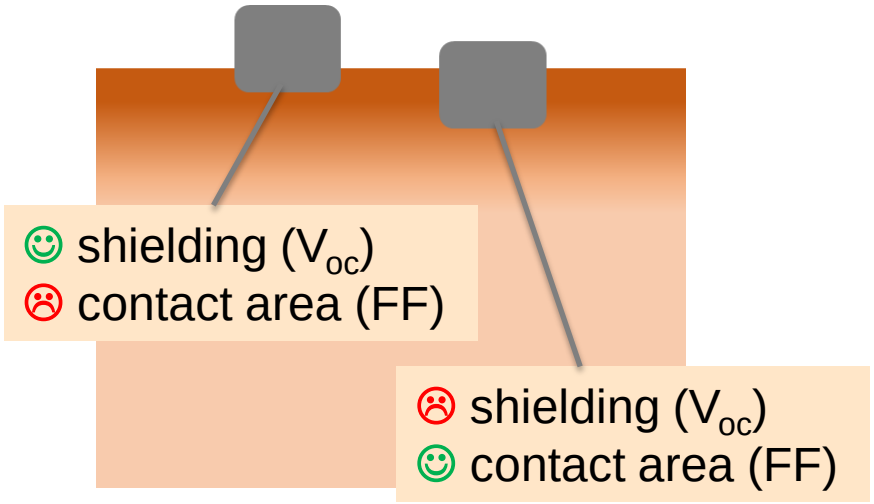


26.1% IBC cell:
p-FZ with POLO contacts
http://isfh.de

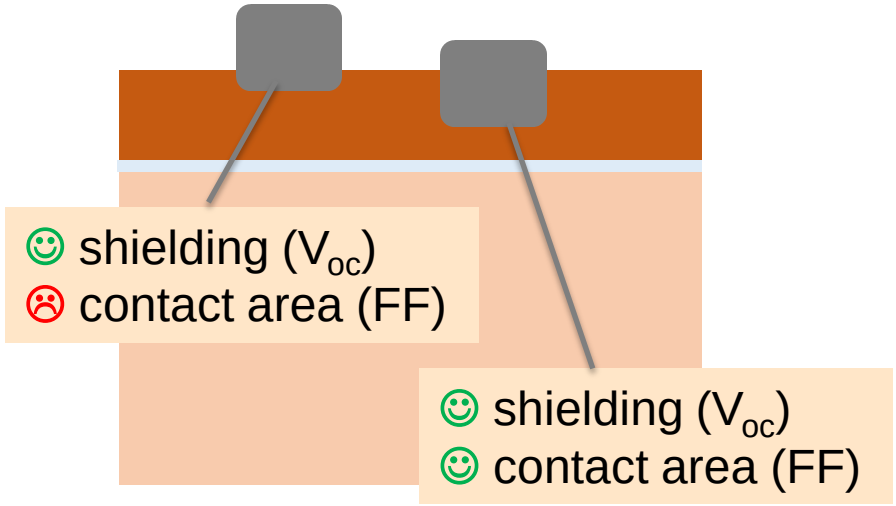


PASSIVATING CONTACTS

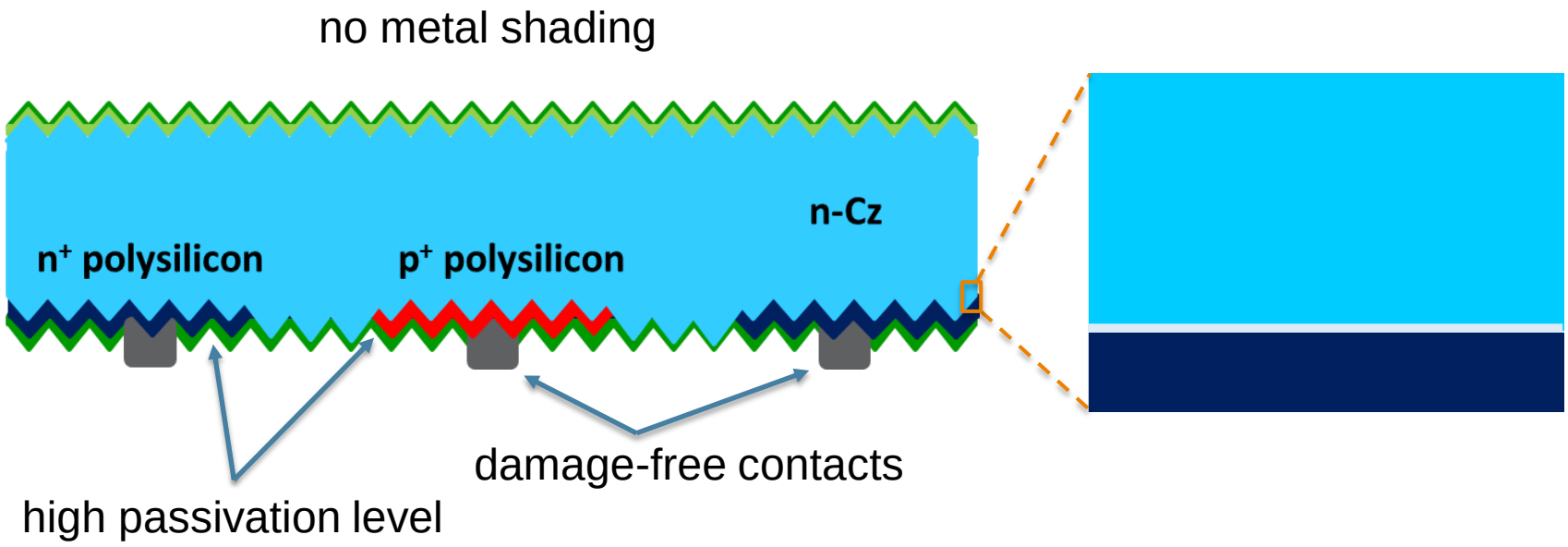
Contact in diffused wafer →
trade-off between contact shielding (Voc) and conductance (FF)



Passivating oxide + highly doped polySi →
no trade-off

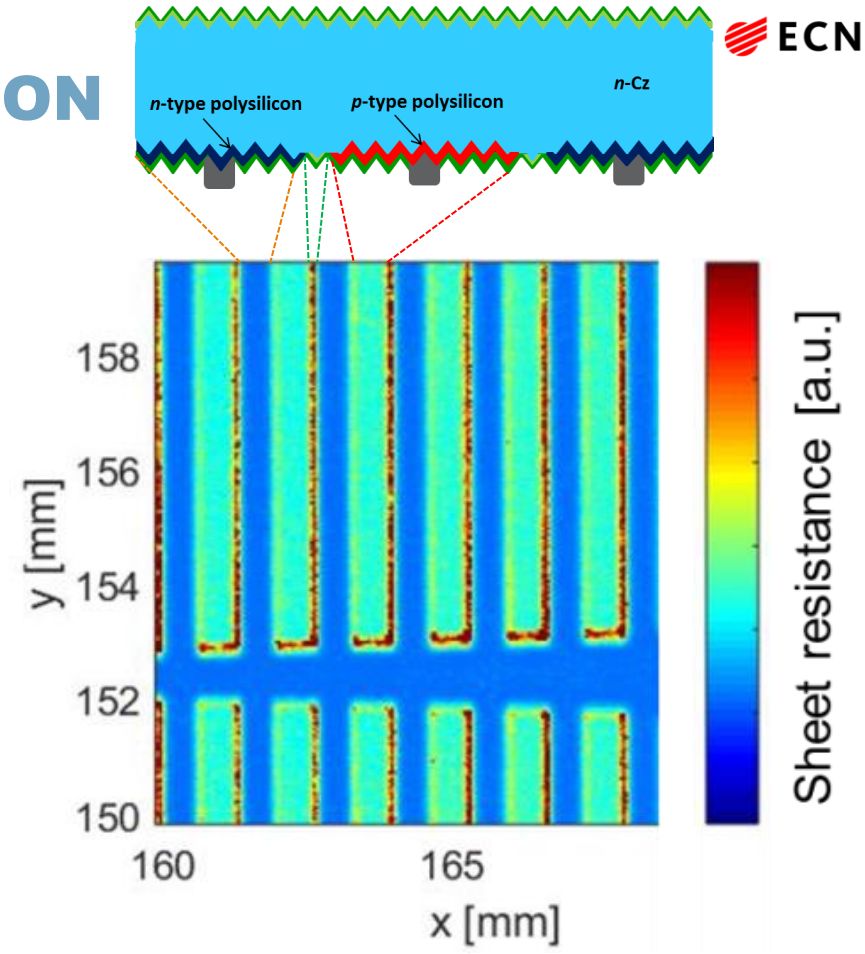


INTEGRATION IN IBC

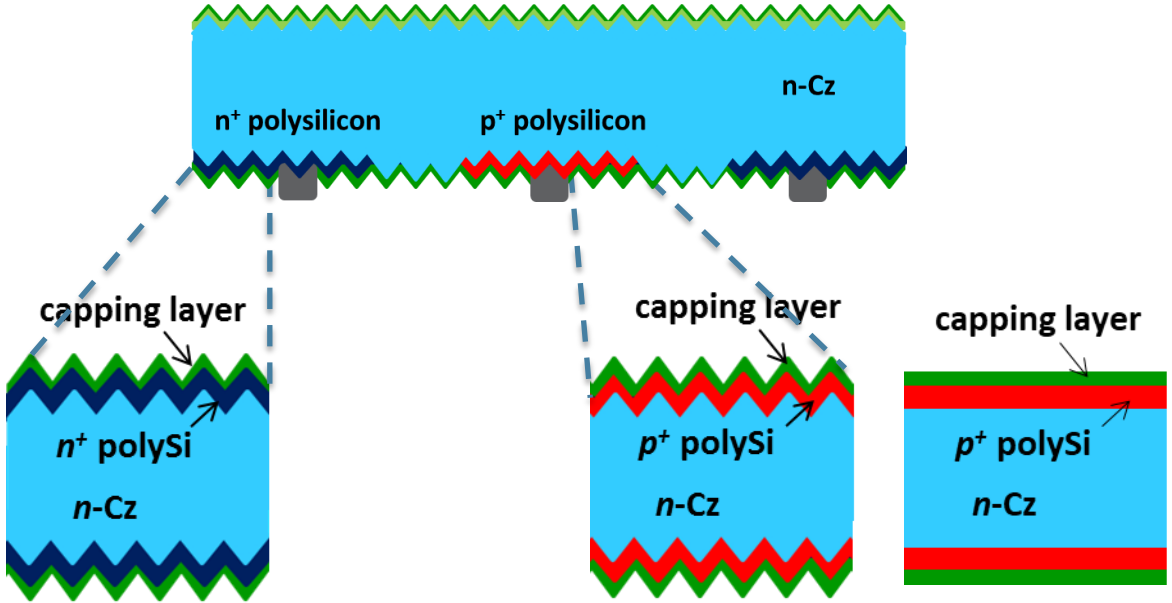


PATTERN EVALUATION

- Structuring of the polySi doped layers
  - by screen printing processes (masking for doping or etching)
- Rsheet evaluation by THz imaging
  - Gap visible
  - Very fast



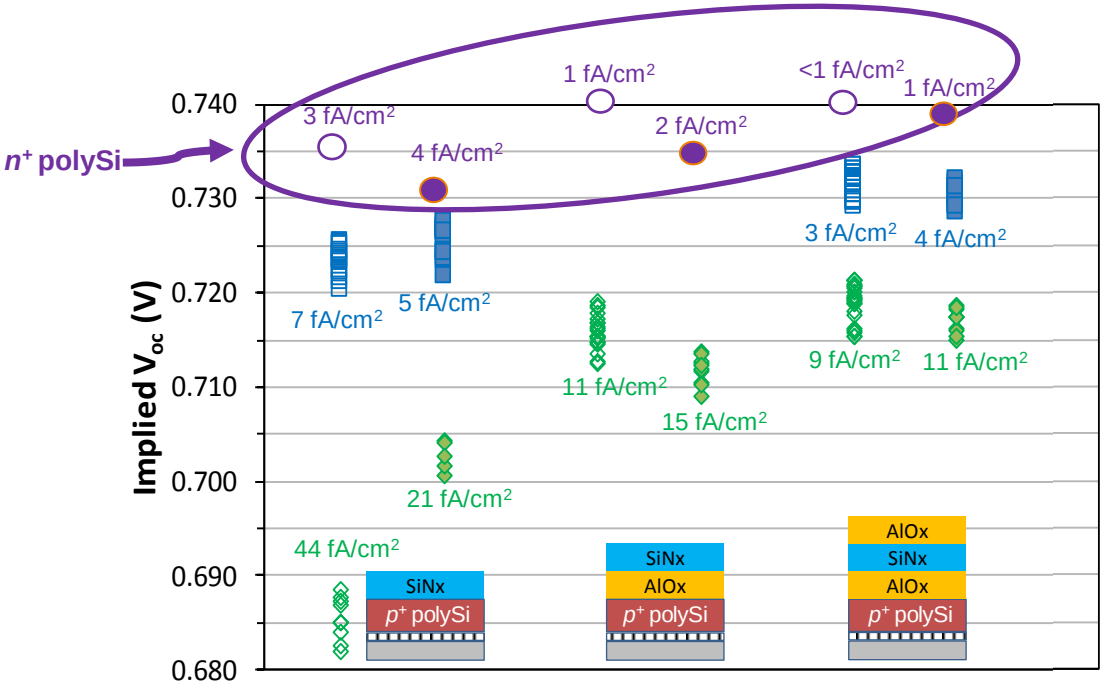
POLYSI SURFACE PASSIVATION

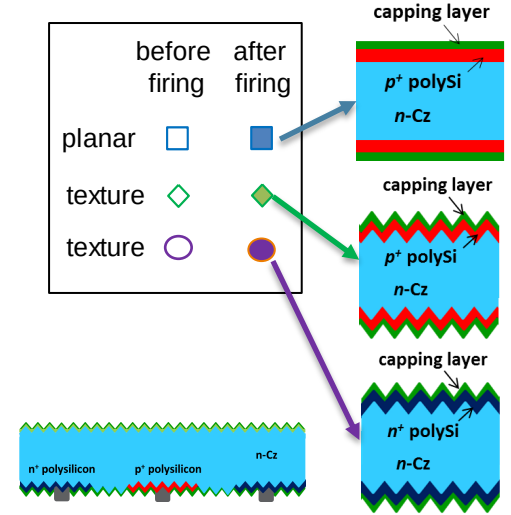


Sample lay-out

- Symmetrical samples
- Textured (& polished)
- Passivating oxide + polySi
- Capping layer

POLYSI PASSIVATION RESULTS



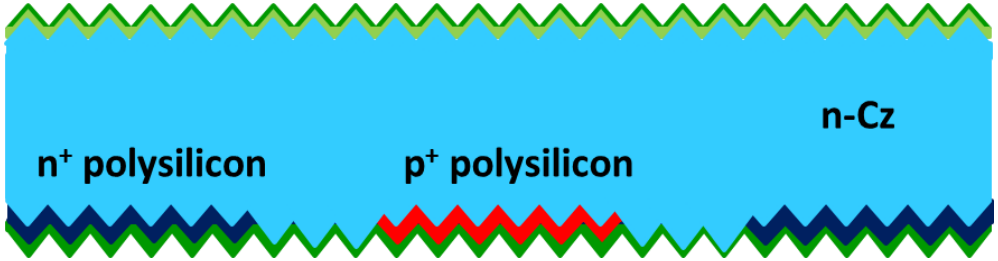


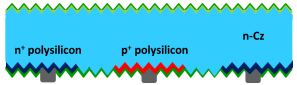
V_{oc} of 730 mV required for 24% efficiency

M.K. Stodolny et al., "Novel schemes of *p*+ polySi hydrogenation implemented in industrial 6" bifacial front-and-rear passivating contacts solar cells", EU-PVSEC 2018 Proceedings, to be published

IBC HALF-FAB PASSIVATION

- High quality passivation: up to 725 mV implied V_{oc}





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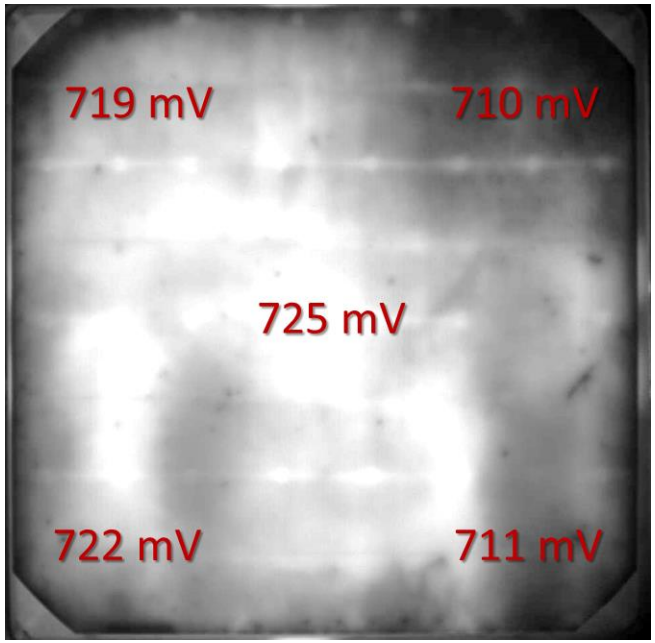
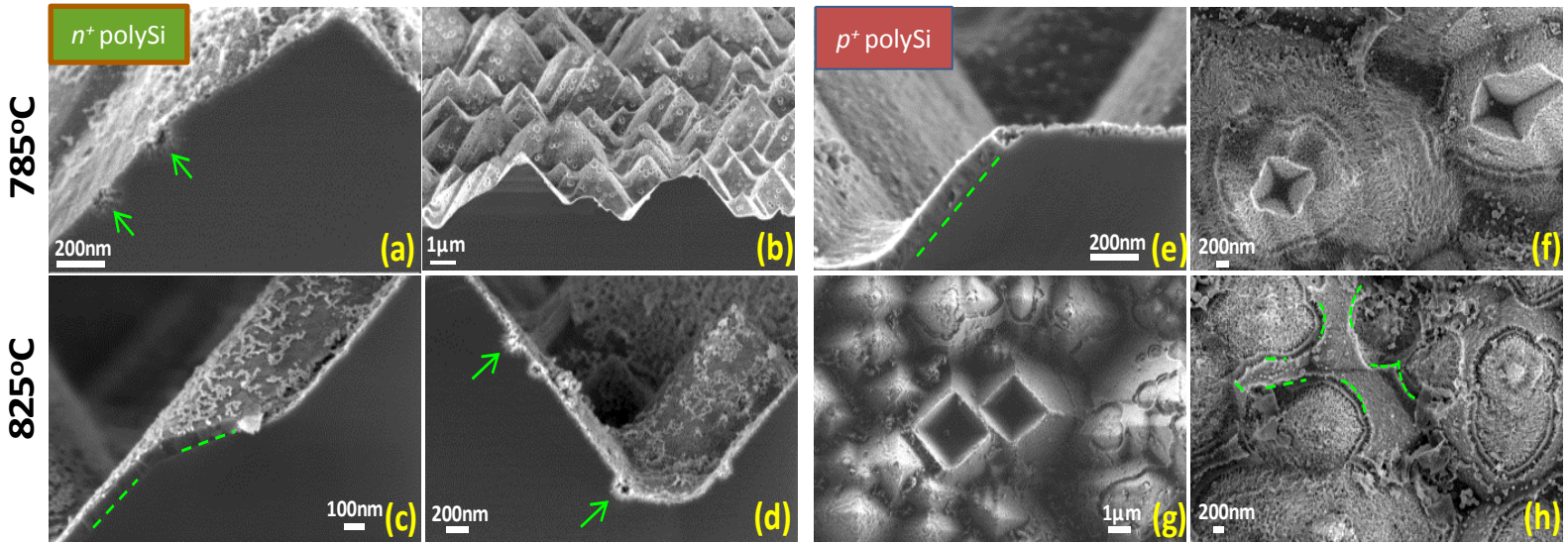


A.A. Mewe et al., “Full wafer size IBC cell with polysilicon passivating contacts”, SiliconPV 2018, AIP Conf. Proc. 1999, 040014-1

POLYSI METALLIZATION DAMAGE

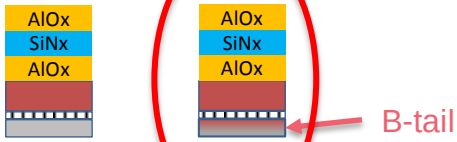


n^+ polySi with Ag paste:
Ag nanoclusters intruding in wafer

p^+ polySi with AgAl paste:
inverted pyramids in wafer

H.E. Çiftpınar et al., "Studies of screen printed metallization for polysilicon based passivating contacts", Energy Procedia 124 (2017) 851-861

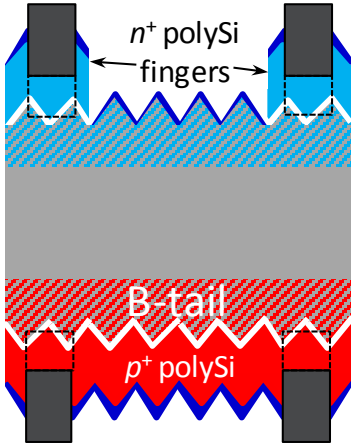
METAL CONTACT QUALITY

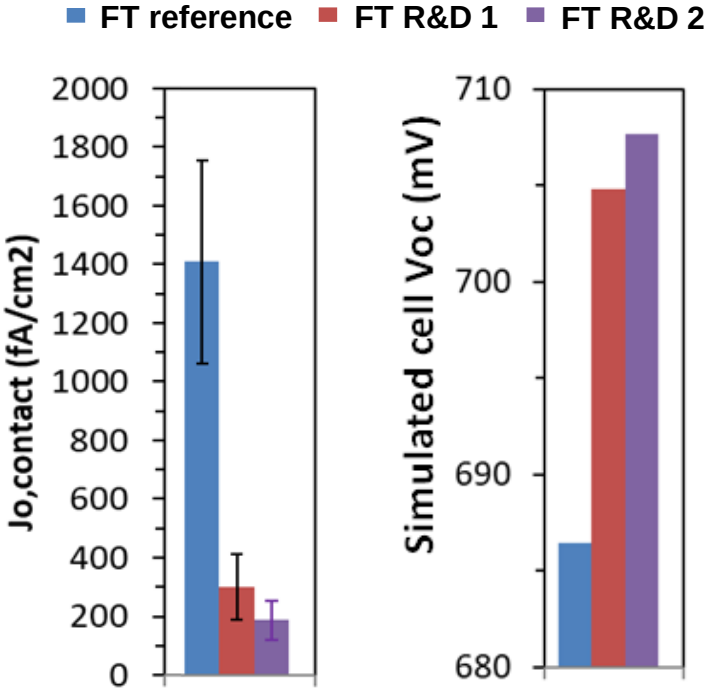


J_o (fA/cm^2) 11 20

Tail below polySi:

- Slight increase in J_0
- Better shielding against paste spikes





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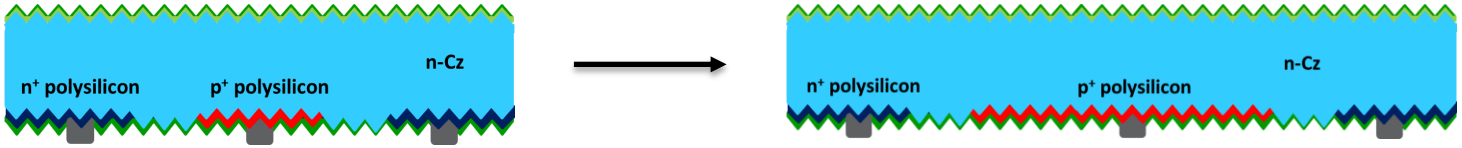
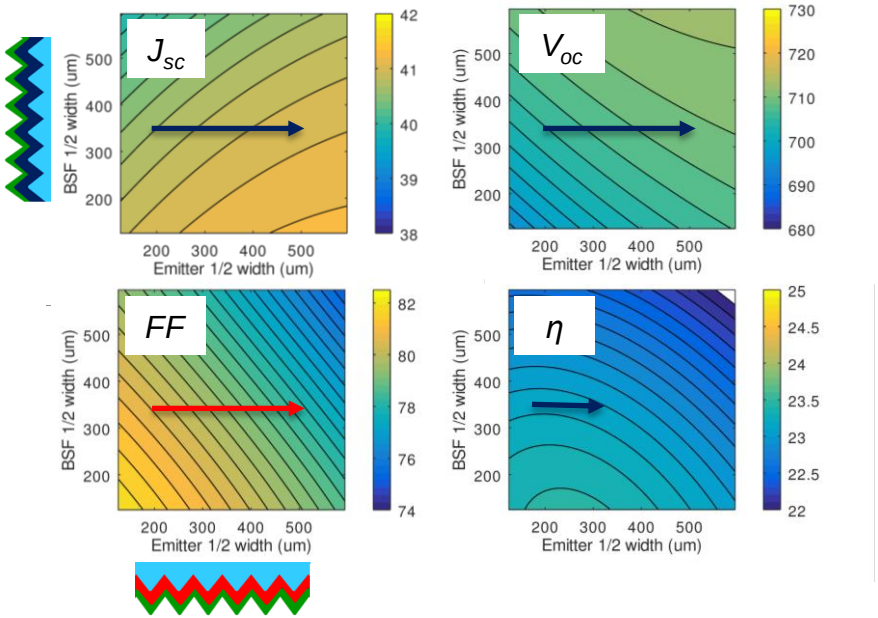
IBC ARCHITECTURE: UNIT CELL DESIGN





Increase of emitter width:

- ↑ Jsc (better collection)
- ↑ Voc (less metal contact)
- ↓ FF (less metal contact)
- Efficiency: good for small unit cell size

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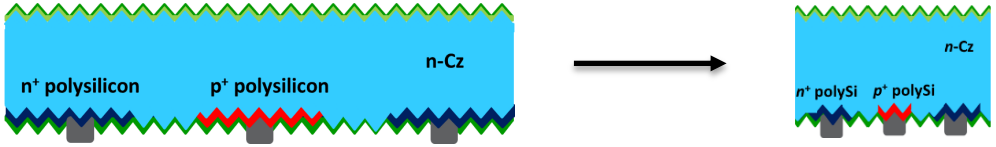
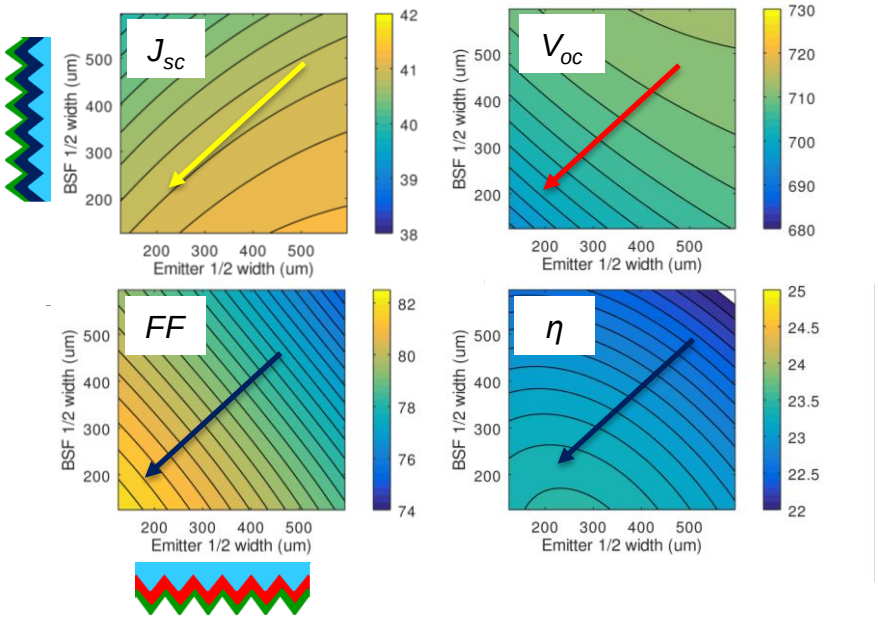
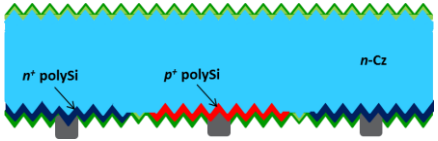


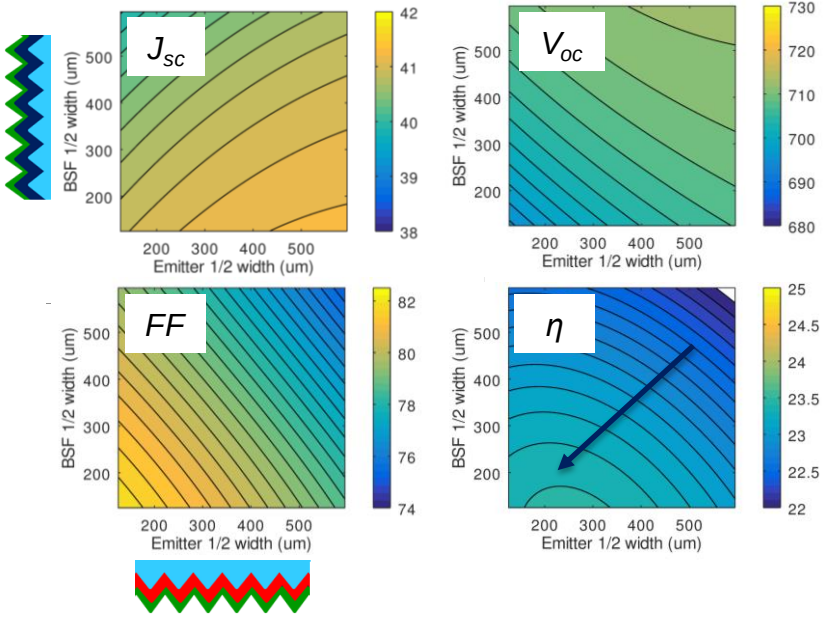


Decrease of unit cell size:

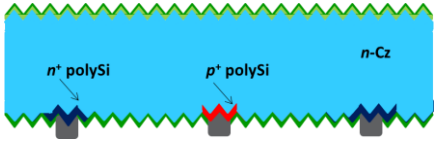
- Jsc (neutral)
- Voc (more metal contact)
- FF (more metal contact)
- Efficiency

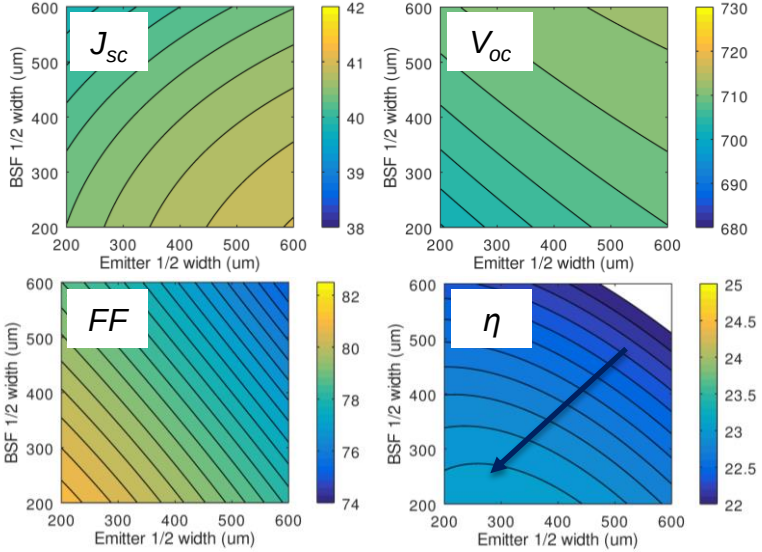
IBC ARCHITECTURE: UNIT CELL DESIGN





bifacial





Only 0.3% loss in η → bifacial compensation

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TEMPRESS AMTECH GROUP

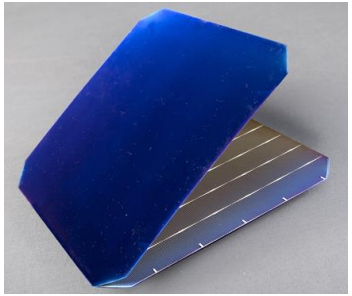
UNIVERSITY OF TWENTE.

LEVITECH

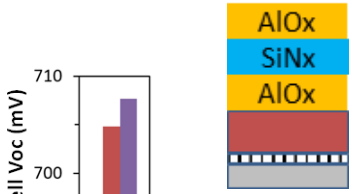
ECN › TNO innovation for life

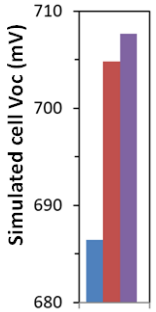
PolySi team

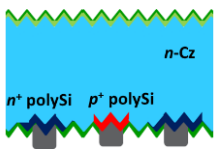
SUMMARY

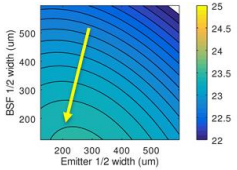


- IBC with passivating polySi contacts
  - High current, high voltage → high efficiency
- polySi surface passivation: H-rich capping
  - p^+ polySi on texture 720 mV (10 fA/cm2)
  - n^+ polySi on texture 740 mV (1 fA/cm2)
  - Firing stable
- Metal contact can be improved
  - New pastes for testing
- IBC cell architecture
  - Small unit cells → higher efficiency
  - Bifacial IBC → similar performance







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