Transparent Passivating Contacts for c-Si Solar Cells

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Where innovation starts
Cholistan Desert, Punjab, Pakistan
Quaid-e-Azam Solar Power Park (QASP)
87,000 panels
5,200,000 crystalline silicon solar cells
(once completed)

Reliable, (>30 years),
Cheap, (<0.06 euro/kWh)
Efficient (>20 %)
• Solar cell:
  1. Absorb as much light as possible
  2. Convert the light to electrons and holes
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  3. Use carrier selective contacts
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  1. Absorb as much light as possible
  2. Convert the light to electrons and holes
  3. Use carrier selective contacts
  4. Prevent carrier-recombination as much as possible

Aluminum-Back Surface Field (Al-BSF)
Crystalline Silicon (c-Si) solar cell
• Solar cell:
  1. Absorb as much light as possible
  2. Convert the light to electrons and holes
  3. Use carrier selective contacts
  4. **Prevent carrier-recombination** as much as possible

![Passivated emitter rear cell (PERC)](image)
Passivated emitter rear cell (PERC)

\[ \sim 17-20 \% \]

\[ 20-22.6 \% \]
Passivated emitter rear cell (PERC)

~17-20 %

20-22.6 %
Cleanroom, TU Eindhoven
• Solar cells:

Aluminum back-surface Field (Al-BSF)  
Passivated emitter rear cell (PERC)

~17-20 %  
20-22.6 %
• Solar cells:

- Aluminum back-surface Field (Al-BSF)

- Passivated emitter rear cell (PERC)

- Bifacial passivating contact cell

1. surface passivation
2. conductivion
3. carrier selectivity
4. transparent
5. low contact resistance

Target >24 %

ZnO, TiO₂, In₂O₃:Sn...?
1. surface passivation
2. conduction
3. carrier selectivity
4. transparent
5. low contact resistance?
Take home messages:

• Modern solar cells are based on **nanotechnology**

• **Atomic layer deposition:**
  - outstanding **control** over composition, electronic and optical properties of thin films,
  - extremely **uniform over large area’s**.

• Many **new applications** in sight;
  - from **passivation** to **transparent passivating contacts**

Book chapter:
“Atomic layer deposition for high-efficiency c-Si solar cells,”
B. Macco, B. W. H. van de Loo and W. M. M. Kessels
ed. J. Bachmann, Wiley 2017
• Thank you for your attention

• Thank our project partners