SHAMAN: Shadow mask localization of thin films for back-contacted crystalline silicon solar cells & energy harvesters

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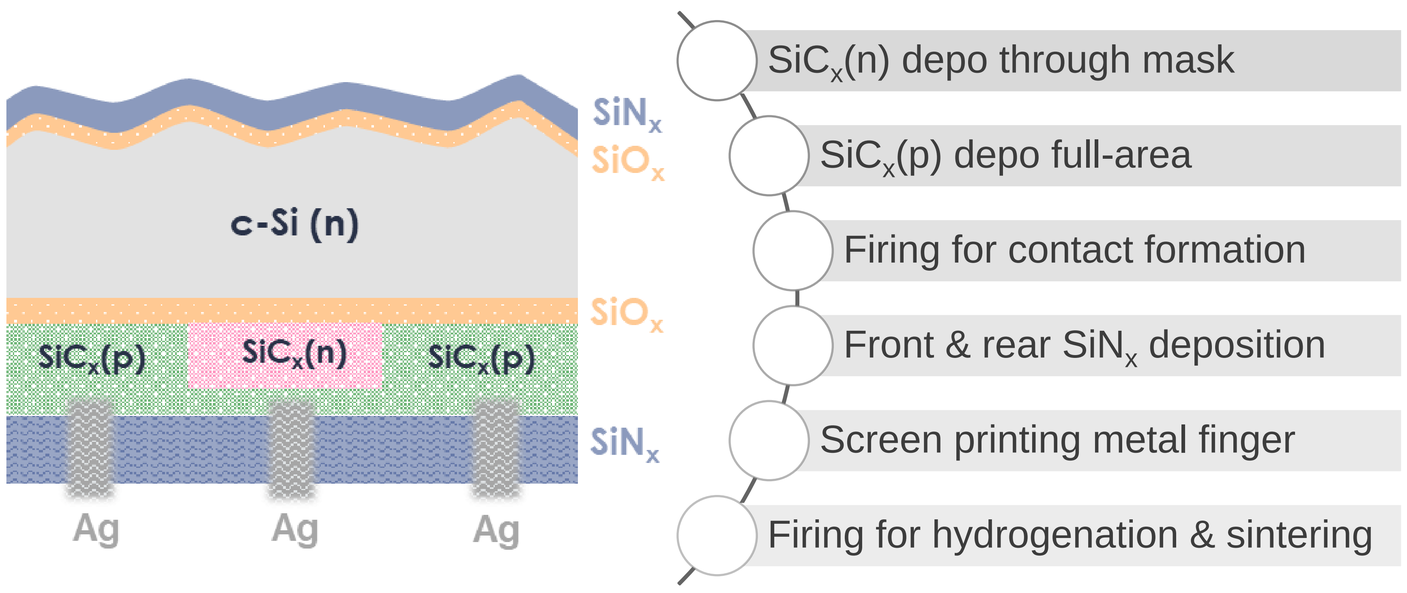
Interdigitated Back-Contacted c-Si Solar Cell Concept with High Temperature Stable Passivating Contacts

Motivation:

High efficiency potential of IBC cells with passivating contact has been demonstrated with efficiencies up to 26.1% using complex processing

→ Up to today there is no established simple way for fabrication of such solar cells

Target back contacted solar cell design and process flow:



Advantages:

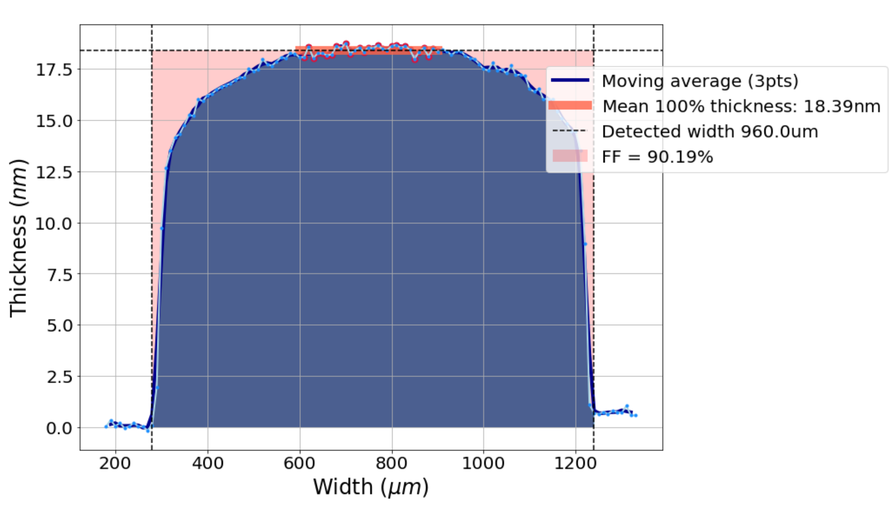
- Flexibility in material choice: Possibility to use low-cost base material thanks to high temperature treatment
  - Impurity gathering
  - Thermal donor killing
- Possibility to avoid TCO and compatibility with industrial firing-through direct metallization processes
- Potentially better compatibility for tandem application with perovskite top cell for 2TT applications

Challenges:

I. Optimizing p&n contact for the same thermal treatment conditions
II. Designing a front side compatible with the rear side
III. Optimizing n/p interface not to have shunt but good charge carrier extraction

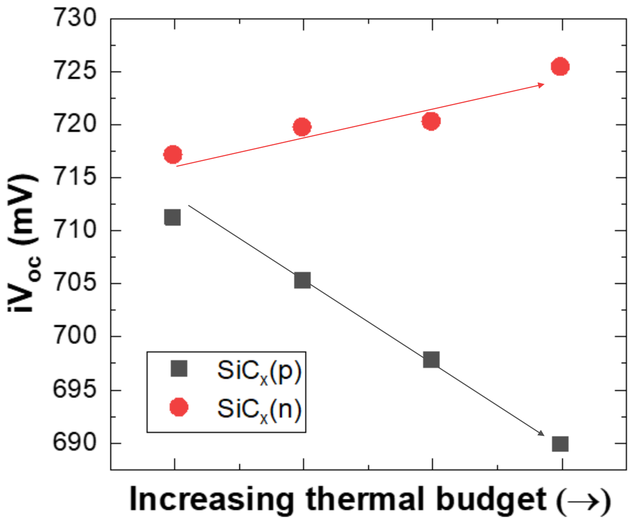
Localization

- Thickness profile of the localized $SiC_x(n)$ shows a good step coverage with filling factor above 90% and no tapering



Surface passivation

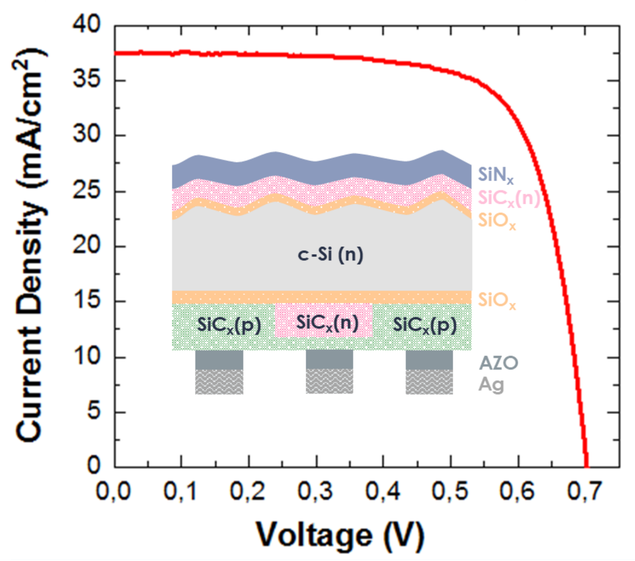
- $SiC_x(p)$ & $SiC_x(n)$ react differently to increase thermal budget and they do not have the same optimum



Device Integration

- Proof-of-concept solar cell integration with low-T metallization

Eff [%]	V_{oc} [mV]	J_{sc} [mA/cm²]	FF [%]
19,2	703,6	37,5	72,6



Conclusions & Outlook

- Proof of concept cell with efficiency up to 19.2% has been demonstrated with single shadow masking and firing process for contact formation of both polarities
- Next steps are (i) high temperature metallization development, (ii) further interface & layer optimization to improve V_{oc} and FF, testing different designs with various pitches

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