# High Temperature – Silicon Oxide HeterjuntiOn solar cells

## Publieke samenvatting / Public summary

### Aanleiding

In today's industrial solar cells, the interface between doped crystalline silicon (c-Si) and the metal contact is a major source of recombination, and therefore of voltage losses. For this reason, high-efficiency c-Si solar cell research was initiated on so-called passivating contacts, in which this recombination loss is significantly reduced. Recently, it was demonstrated that solar cells with passivating contacts can obtain record-high conversion efficiencies; over 25% for front-to-rear contacted poly-Si based cells1 and over 26% for interdigitated back contacted cells (IBC) 2, integrating doped poly-Si and a-Si:H (SHJ) based passivating contacts, respectively. However, both types of passivating contacts are not transparent for a large, relevant part of the solar spectrum and/or are not compatible with high temperature industrially screen-printed metallization processes. Here, we will develop passivating contacts that are more transparent than their existing counterparts and maintain their passivating properties under high temperature conditions.

### Doelstelling

In this project, carrier-selective passivating contacts based on doped poly-SiOx alloys, with high transparency and high thermal stability, will be developed. The developed materials can be applied at both sides of front-to-rear contacted and bifacial solar cells. The high carrier selectivity and excellent passivation properties of the poly-SiOx contacts will induce a high open circuit voltage (VOC), while their

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high transparency due to the oxygen alloying will lead to increased high short circuit current density (JSC) as compared to other silicon based passivating contacts. Additionally, to also achieve a good solar cell fill factor (FF) without the need of a transparent conductive oxide (TCO), we shall optimize the in-diffused doping concentration. This will facilitate lateral transport of the carriers and enhance their tunneling probability through the SiO2 interface layer in between the selective poly-SiOx layer and the wafer. By achieving these excellent VOC, JSC and FF, and therefore high conversion efficiency, while at the same time using industrial LPCVD or PECVD to deposit a fully SiOx-based passivating contact, the LCoE of PV electricity will be reduced.

**Korte omschrijving**

TUD will develop and test poly-SiOx passivating contact materials in their lab, and ECN and Tempress will integrate their findings into the processes to the Tempress systems at the ECN site. In parallel, ECN and Tempress will work on development of LPCVD and PECVD doped SiOx layers in the Tempress systems, adapting their furnaces to poly-SiOx layer deposition. When promising results are achieved on symmetric test structures, i.e. wafers with poly-SiOx stacks on both sides, solar cells containing these stacks will be fabricated. TUD will use their cleanroom facilities for development of lab scale (9 cm2) solar cells, to demonstrate a high efficiency proof-of-concept solar cell by making use of the advanced laboratory techniques available in their lab. ECN will explore the integration potential of these newly developed materials in solar cells on an industrially-relevant scale, i.e. 6” wafers, making use of their industrial pilot line equipment.

**Resultaat**

The project will investigate the structural, electrical, and optical nature and passivation performance of novel doped poly-SiOx layers. The combination of high-temperature stability on the one hand, and improved transparency on the other hand, gives these layers an important advantage over existing silicon-based passivating contacts. This will enable

high efficiency c-Si solar cells that are compatible with simplified low-cost industry-feasible metallization steps, while combining high short circuit current values and high open circuit voltage.

De data in deze applicatie is afkomstig van de Rijksdienst voor Ondernemend Nederland (RVO) en wordt in samenwerking met de Topsector Energie ontsloten.
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