

Circular silicon production from end of life solar cells

Publieke samenvatting / Public summary

Aanleiding

According to the current growth scenarios for photovoltaic energy generation, by 2050 more than 60 terawatt peak (TWp) of solar power will be installed worldwide. That is 100 times more than the amount installed at the end of 2019. A key compound involved in solar cell production is silicon, produced by reduction of the mineral quartzite. This compound is in principle available in sufficient quantities, however, the entire process from quartzite to solar grade silicon involves several very energy intensive purification steps. At the same time an exponentially increasing number of discarded PV panels is going to pose a problem considering the vast amount of waste associated. Currently this waste is processed into raw building materials for e.g. isolation (glass wool) and metallurgical silicon with a low purity and low economic value, not respecting the amount of energy spent to manufacture the original solar cells. In view of the intention to convert to a circular and truly sustainable economy this is an undesired situation.

Doelstelling

This project focuses on silicon, representing a valuable material given its purity and the amount of energy put into it with its manufacturing. The aim is to reuse this material at a higher level than today's common practice and ultimately again into solar cells. Presently the PV silicon industry is rather conservative and making any changes to the existing production materials and processes meets

Projectinformatie / Project information

Projectnummer / Project number
TIND321003

Subsidiebedrag / Grant amount
€ 322.562,00

Algemene informatie / General information

Penvoerder / Secretariat
Nederlandse Organisatie voor
Toegepast-Natuurwetenschappelijk
Onderzoek TNO

Publicaties en materialen / Publications and attachments

- 06.11.2025

Eindrapport TIND321003

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serious barriers. That is for good reasons and linked to product quality. Because of this it is difficult to introduce recycle silicon of unknown source and purity in the production process. Given the relatively small volumes of today's available recycle PV silicon it is difficult to invest in purification of this material up to solar grade silicon. This makes the barrier for reuse in PV production currently too high, rendering it difficult to find a business case. To overcome this barrier, two applications of high grade silicon (other than solar cells) have been identified as potential market launching opportunities: silicon-aluminum alloy and improved lithium battery anodes.

Korte omschrijving

The silicon scrap harvested from end of life solar panels contains several impurities originating from the cell metallization and dopants. To render the silicon suitable for the applications foreseen in this project a purification step is required. Purification will be conducted by means of a novel technology, an existing technology that will be applied for new purposes in this case. Using both end of life solar cells and rejected solar cells the process will be optimized to produce silicon with the required purity levels. The material will be characterized by several analytical techniques to evaluate and fine-tune the settings for the novel process in a number of feedback loops. Experimental batches of purified silicon will be used to produce silicon-aluminum (Silumin) alloy and evaluate its properties. Considering the battery anode application the purified silicon recycle will be transformed into micron sized silicon particles with a nano-scale porous silicon structure. Laboratory scale test batteries will be produced and the performance evaluated.

Resultaat

The project will result in a process for high value circular manufactured silicon products based on waste PV panels, in the category R7 and R8 (repurpose and recycle) of the 'Planbureau voor de Leefomgeving (PBL)' circularity ladder. The recycled silicon will be first applied in silicon aluminum alloy and batteries for e-cars with the final goal to provide

a fully circular solar grade silicon wafer for use in solar panels. Applying recycled silicon instead of newly mined and processed material results in a much lower carbon footprint of the final products involved, due to strongly reduced CO2 emissions. Based on the project results an impetus is given to activate the Dutch recycling industry towards a circular production.

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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