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Project Factsheet

CHEOPS

Production technology to achieve low Cost and Highly Efficient phOtovoltaic Perovskite Solar cells

Background

In photovoltaics (PV) research, a particular class of new materials has recently generated great interest: Semiconductors based on organometallic halide compounds with the perovskite crystal structure promise to enable the production of solar cells that are at the same time extremely efficient and very low cost. They are commonly termed „perovskites“, although they are synthetic compounds that only share the crystal structure with the naturally occurring mineral perovskite named after the Russian mineralogist L. A. Perovski.

The use of synthetic perovskites for solar cells was first proposed only a few years ago. At lab scale, energy conversion by perovskite devices was since then rapidly advanced to efficiencies exceeding 20%. But only few attempts at upscaling have been made, yielding significantly reduced efficiencies below 9%. In addition, questions about material stability and reliable measurement procedures are still under discussion.

Objectives

The main goal of the CHEOPS project is to develop materials and production processes for both upscaling the perovskite photovoltaics technology and producing high efficiency solar cells in a tandem configuration.

In terms of upscaling the lab results, the CHEOPS consortium aims to achieve solar modules manufactured in a pre-production environment while maintaining high efficiencies (above 14% stable efficiency in modules of at least 15x15cm^2). As the production processes will be designed for large volume production at very low-cost, this will demonstrate the potential of perovskite cells as a technology well suited for building-integrated photovoltaics.

A tandem implies that a perovskite top cell is joined with a bottom crystalline silicon cell. Such tandem cells are currently expected to have the best chances to succeed on the photovoltaics market because their production could most likely be integrated into existing manufacturing processes and equipment. Within the CHEOPS project, the objective is to achieve very high efficiency (exceeding 29% on 2x2cm^2 cells) in a tandem configuration. The CHEOPS consortium will also perform a sustainability assessment from a life-cycle perspective to anticipate potential risks for the technology (including business, technological, environmental, social & political risks). We will establish a quantified future development roadmap as well as protocols for stability testing and for reliable measurements.

Funding Programme:

Horizon 2020 Framework Programme of the European Union

Project Coordinator:

Dr Sylvain Nicolay,
Centre Suisse d'Electronique et de Microtechnique (CSEM), CH

Project Duration:

01/02/2016 – 31/01/2019

Project Budget:

5 million euro

Project Website:

www.cheops-project.eu

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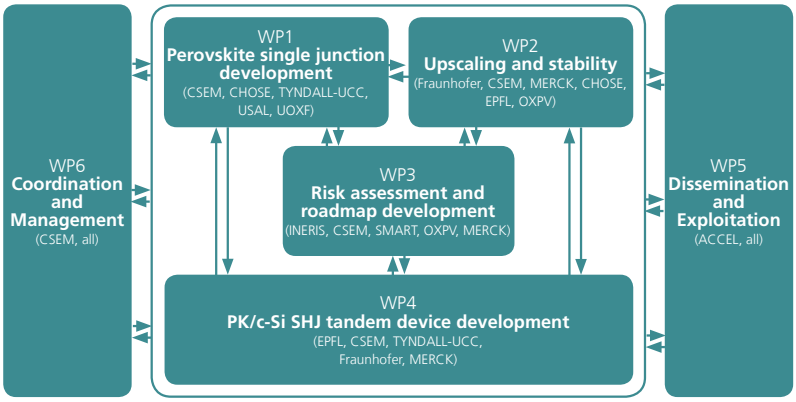
Activities

CHEOPS is a 3-year project and the scientific and technical developments will be carried out in 4 interrelated work packages (WP1-WP4, see Figure).



For the development of single junction devices, WP1 will explore solutions to achieve homogeneous deposition processes on large scale leading to higher efficiencies. WP2 will then combine these developments with proper encapsulation techniques and possibly more stable charge transport material into a large scale highly efficient and stable device demonstrator.

Regarding tandem devices, members of WP4 will develop a specific all low temperature (<200°C) perovskite top cell approach compatible with monolithic integration on a silicon heterojunction bottom cell. First, the partners will work on "simple" tandem integration based on an existing bottom cell scheme, and once an optimised low temperature process will be established for the top cell, refinement using improved light trapping schemes, contacting layers with high transparency and optical index matching layers will be introduced in the device to further maximise the efficiency.

WP3 will assess the potential societal and technological risks and carry out a life-cycle analysis to support the societal acceptance of the newly developed technology. Based on the process information such as takt time, material usage, output power scattering and device stability, we will establish a specific cost of ownership calculation protocol based on existing cost evaluation procedures.

Impact

In a joint effort of key players in Europe, CHEOPS will decisively advance the perovskite PV technology towards the market as a very cost-effective and resource-efficient technology for renewable energy generation. In line with EU policy objectives, the project thus supports Europe in mastering the challenge of making its energy systems clean, secure and efficient, while ensuring industrial leadership in low-carbon energy technologies.

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