Technology Offer

TT-Ref. 2012-121

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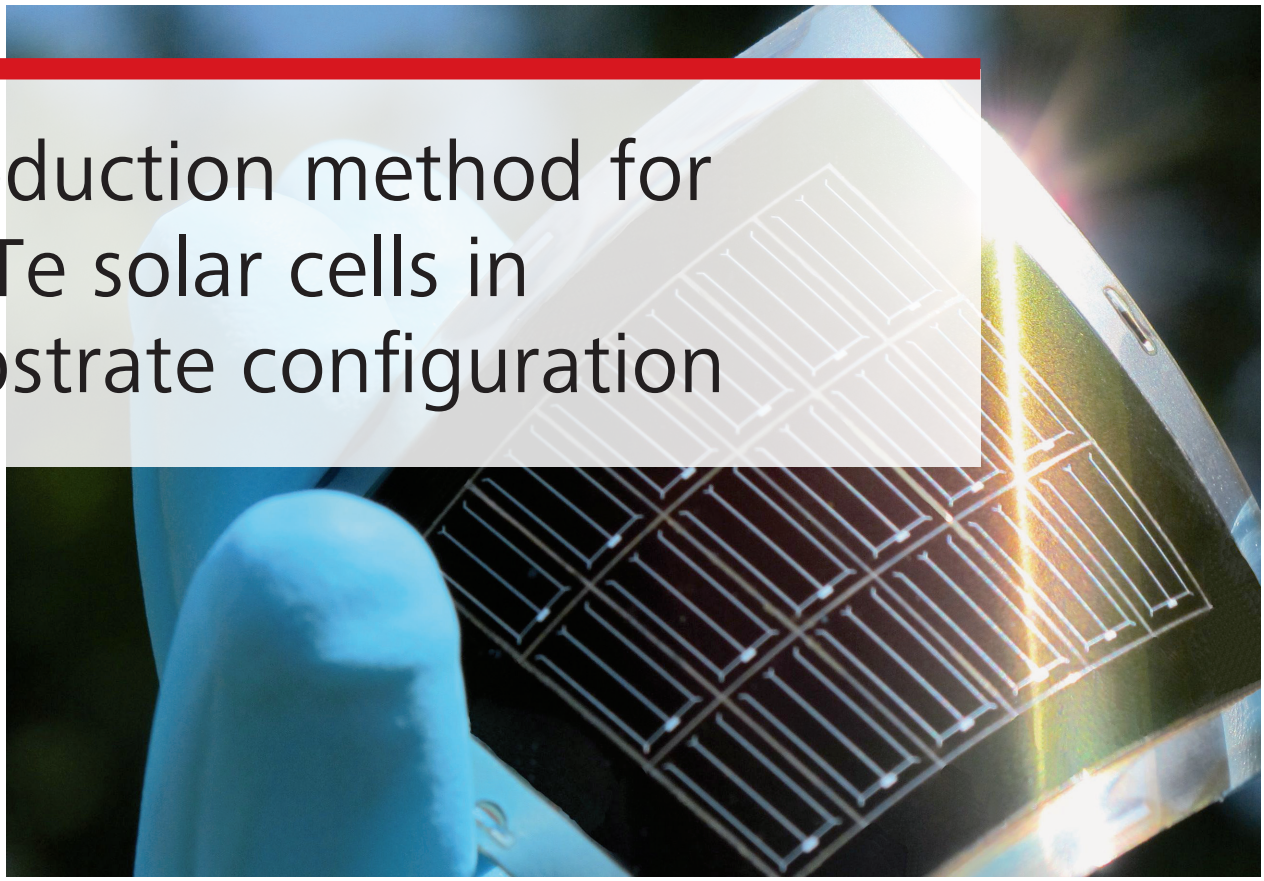
Materials Science and Technology

Production method for CdTe solar cells in substrate configuration



Invention

This invention relates to an energy-efficient, low-temperature (<450 °C) growth process for CdTe solar cells and modules in substrate configuration, which employs a novel method for p-type doping of the absorber [1,2,3]. The invention uses only industrially relevant processes, is easily scalable and has proven to yield devices with electronic properties comparable to the world record devices grown in the conventional device configuration but at the same time enabeling lower manufacturing costs.

Background

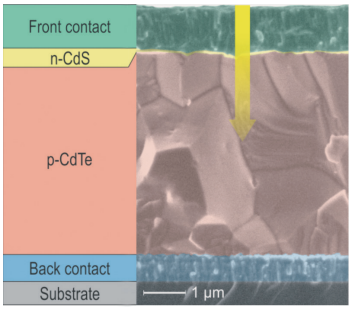
CdTe photovoltaics in the conventional configuration are a proven technology for the large scale production of low-cost (currently below 0.6 $/$W_p$) photovoltaic modules. A big step forward in cost reduction is expected through the growth of solar cells on flexible metal foil substrates using roll-to-roll production. However, for the growth on flexible metal foil substrates, solar cells must be grown in an unconventional configuration, the so-called "substrate configuration", which has previously resulted in low efficiencies (below 8% for metal foil substrates) due to inferior electronic properties of the device. This problem is solved by this patented process enabling exact control on semiconductor doping leading to excellent electronic properties and superior efficiencies.

Advantages

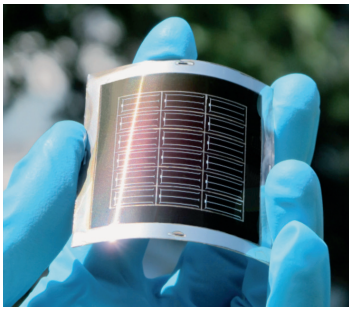
Compared to state-of-the art substrate configuration CdTe solar cells, the invention enables significantly improved electronic properties of the devices. This yields higher efficiencies and better process reproducibility leading to lower cost/W_p compared to alternative processes. In proof of concept experiments certified world record efficiencies of 13.5% and 11.5% are already reached on glass and flexible metal foil substrates, which significantly exceed the efficiencies achieved with alternative processes. Further optimization of the process should yield efficiencies towards 20%.

Applications

This invention opens new business opportunities based on a material which has already proven low cost production of high efficiency solar modules.
This technology has inherent advantages of industrialization with low investment and low risks.
The technology can be applied both on rigid glass substrate and on flexible low cost substrates, e.g. metal foil or polyimide film. The growth on flexible foils enables roll-to-roll production, which significantly reduces production costs. Additionally to the advantages in processing, the flexible and lightweight product offers unique selling propositions: Low weight as well as module flexibility and rollability.



Structure of CdTe solar cells in substrate configuration



CdTe solar cells on flexible metal foil

Ownership

Empa, Swiss Federal Laboratories for Materials Testing and Research, Überlandstrasse 129, CH-8600 Dübendorf; *Patent pending*

References

[1] Kranz et al., Doping of polycrystalline CdTe for high efficiency solar cells on flexible metal foil, Nat. Commun. 4, 2306 (2013).
[2] Kranz et al., Tailoring Impurity Distribution in Polycrystalline CdTe Solar Cells for Enhanced Minority Carrier Lifetime, Adv. Energy Mater. DOI: 10.1002/aenm.201301400 (2013).
[3] Gretener et al., CdTe/CdS thin film solar cells grown in substrate configuration, Prog. Photovolt.: Res. Appl. 21, 1580 (2013).

Keywords

Photovoltaics, solar cells, CdTe, flexible, metal foil substrate, substrate configuration, doping, copper

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