International Advanced Research Centre for Powder Metallurgy & New Materials (ARCI)

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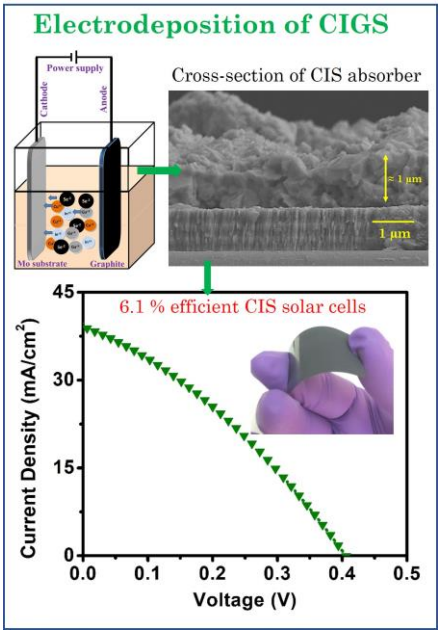
Non-Vacuum Pulse Electrodeposited CIGS Solar Cells on Flexible Substrates

Overview

Flexible photovoltaics (PV) are the need of the hour for various energy applications. Cu(In,Ga)Se_2 (CIGS) possessing large absorption coefficient and excellent log-term stability is a potential candidate for flexible PV with already demonstrated commercial maturity. However, cost is the major aspect for portable energy applications even with a slight compromise on device efficiencies. Electrodeposition having the ability for roll-to-roll manufacturing with lower capital investment is among the most explored processes for CIGS. Pulse electrodeposition is an advanced feature which significantly simplifies the conventional process while improving the absorber quality owing to its crucial pulse parameters is being pursued for the realization of low-cost flexible CIGS solar cells. Additionally, an all non-vacuum based CIGS solar cell on Mo substrates is being fabricated with other device layers like CdS, ZnO and AZO are solution processed while ZnS is also used as replacement for CdS towards Cd-free CIGS solar cells.

Key Features

- A simple economic pulse electrodeposition route for CIGS solar cells
- Efficient utility of electroreduction and oxidation phenomena
- Process devoid of any complexing agents, additives and third reference electrode
- Suitable for large area and roll-to-roll manufacturing on flexible substrates



Potential Applications

- Portable energy needs
- Building integrated photovoltaics
- Photoelectrochemical cells

Technology Readiness Level (TRL)

- Demonstration of 6.1 % efficient CIS solar cells at laboratory scale
- Scale up of uniform CIGS absorbers till 8 x 8 cm^2

IPDI*	1	2	3	4	5	6	7	8	9	10
Activities	*Basic concepts and understanding ofunderlying scientific principles*	*Short listing possible applications*	*Research to prove technical feasibility for targeted application*	*Coupon level testing in stimulated conditions*	*Check repeatability/ consistency at coupon level*	*Prototype testing in real-life conditions*	*Check repeatability/ consistency at prototype level*	*Reassessing feasibility (IP, competition technology, commercial)*	*Initiate technology transfer*	*Support in stabilizing production*
Status										

IPDI : Intellectual Property Development Indices

Major Patents/Publications

1. B. V. Sarada, Sreekanth Mandati and Shrikant V. Joshi, A novel electrochemical method for manufacturing CIGS thin-films containing nanomesh-like structures, Patent filed, File No: 426/DL/2015, Date: 16th February, 2015
2. Sreekanth Mandati, S. R. Dey, S. V. Joshi and B. V. Sarada, Cu(In,Ga)Se_2 Films with Branched Nanorod Architectures Fabricated by Environmental-friendly Pulse-reverse Electrodeposition Route, ACS Sustainable Chemistry and Engineering 6(11), 13787 (2018)
3. Sreekanth Mandati, Suhash R. Dey, Shrikant V. Joshi and Bulusu V. Sarada, Two-dimensional CuIn1-xGaxSe2 Nano-flakes by Pulse Electrodeposition for Photovoltaic Applications, Solar Energy 181, 396 (2019)
4. Divya B, Sreekanth Mandati, Ramachandraiah A, Bulusu V. Sarada, Room Temperature Pulse Electrodeposition of CdS Thin Films for Application in Solar Cells and Photoelectrochemical cells, ECS Journal of Solid State Science and Technology 7(8), P440 (2018)

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