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

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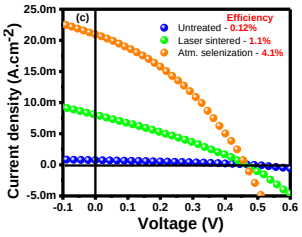
CIGS thin film solar cell by non-vacuum based process using synthesized NP's

Overview

Non-vacuum processes have great interest for low cost chalcopyrite based photovoltaic technologies in CIGS thin film solar cell fabrication. A key feature in these processes is the selenization treatment has significant impact on the microstructure of the absorbers and, in turn, are determining for the performance of the device. In this context, a two step non-vacuum process, spraying of sonochemically synthesized CIGS nanoparticles suspension followed by post treatment (IPL/laser treatment or atmospheric selenization). A non-vacuum based route using Photonic sintering, novel atmospheric pressure thermal annealing is being developed to reduce the number of processing steps in complete cell fabrication and has great potential to be incorporated in to roll-to-roll manufacturing of cost effective CIGS thin film solar cells.

Key Features

- Scalable non vacuum manufacturing process for CIGS without toxic selenization
- Simple ambient sonochemical synthesis for CIGS NP's with high material utilization.
- Solution process using spraying technique
- Environmentally benign flash light and/laser post-treatment method
- Processing on Light weight and flexible glass substrate



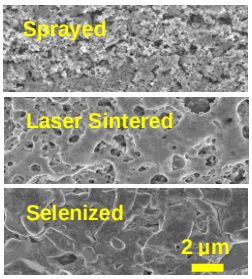
IV curve of non-vacuum processed CIGS thin film solar cell

Potential Applications

- Building integrated photovoltaic (BIPV)
- Application for DC power appliance
- Powering Internet on things (IOT) based applications

Present status

- Fabricated device demonstrated photo conversion efficiency exceeding 4% on lab scale
- Performance improvement by fine tuning the process parameters is underway



Surface morphology of CIGS thin film absorber on Mo glass by non-vacuum ink based route

Technology Readiness Level (TRL)

IPDI*	1	2	3	4	5	6	7	8	9	10
Activities	*Basic concepts and understanding of underlying 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. Improved method of manufacturing copper-indium-gallium diselenide thin films by laser treatment. Patent application No: 2084/DEL/2212, Date: 05/07/2012, Inventors: Sanjay R. Dhage, Manish Tak and Shrikant V. Joshi

2. Sonochemical synthesis of CuIn0. 7Ga0. 3Se2 nanoparticles for thin film photo absorber application, Amol C. Badgujar, Rajiv O. Dusane and Sanjay R. Dhage, *Material Science in Semiconductor Processing* 81 (2018) 17.

3. Cu (In, Ga) Se 2 thin film absorber layer by flash light post-treatment, Amol C. Badgujar, Rajiv O. Dusane and Sanjay R. Dhage, *Vacuum* 153 (2018) 191.

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