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

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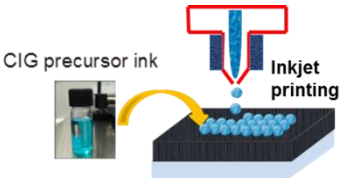
Non-vacuum Inkjet printing of CIGS thin film solar cell using molecular precursors

Overview

The existing high temperature and vacuum processing and selenization treatment used in CIGS thin film solar cell fabrication are neither cost effective nor easily scalable to high volume production. Non-vacuum processes have great interest for low cost chalcopyrite based photovoltaic technologies. 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 (inkjet printing and selenization) for the preparation of CIGS absorber layer is being developed at ARCI. The process is novel and expected to have large impact in CIGS PV industry in terms of cost reduction and easy processing. Moreover, the non-vacuum route will reduce the number of processing steps in complete cell fabrication.

Key Features

- Scalable Inkjet printing process for quality CIGS thin film absorber preparation
- High material utilization technique because of drop on demand feature
- Mask-less and non-contact approach
- Fast and cost effective atmospheric pressure RTP selenization process
- Processable on Light weight and flexible glass substrat.



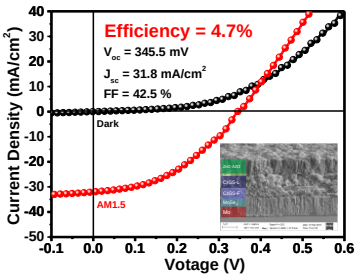
Schematic of inkjet printing of CIG precursor film

Potential Applications

- Building integrated photovoltaics (BIPV)
- Application for DC power appliance

Present status

- Achieved 4.7% photo conversion efficiency on lab scale device,
- Proved technical feasibility of process and proof of concept
- Performance improvement and evaluation underway



AM1.5 and Dark I-V of ink jet processed CIGS thin film solar cell (inset: Device x-section)

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. Chalcopyrite CIGS absorber layer by inkjet printing for photovoltaic application, Brijesh Singh Yadav, Suhash Ranjan Dey and Sanjay R Dhage, material today proceedings, volume 4, issue 14 (2017)12480-12483

2. Effective printing strategy for Cu (In, Ga) Se_2 thin film absorber using aqueous ink for solar cell application" Brijesh Singh Yadav, Suhash Ranjan Dey and Sanjay R Dhage, Solar Energy 179 (2019) 363–370

3. Role of selenium content in selenization of inkjet printed CIGSe2 thin film solar cell" Brijesh Singh Yadav, Suhash Ranjan Dey and Sanjay R Dhage, AIP Conference Proceedings 2082 (2019) 050001

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