

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

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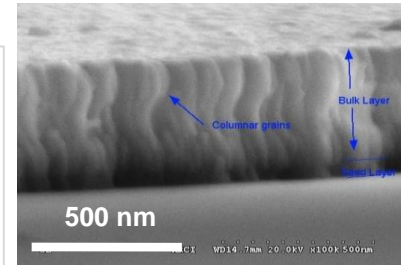
Development of Molybdenum bilayer thin film on large area

Overview

CIGS solar cell fabrication begins with sputter coated Molybdenum (Mo) on soda lime glass (SLG) substrate which acts as a back contact, likewise Mo thin film back contact is also exclusively being used in CZTS, CdTe and Sb₂Se₃ thin film solar cells. Moreover, Mo thin films has wide range of applications, as an electrode in optoelectrical systems. Properties of Mo thin film are dependent upon various sputtering parameters such as power, pressure and substrate temperature. Precise optimization of sputter process parameters such as sputtering power and deposition pressure in the bilayer approach can effectively achieve high electrical conductivity and strong adhesion; in addition, substrate cleaning and surface treatment play a crucial role influencing adhesion between SLG and Mo thin film. Surface conditioning of glass substrate to sputter coat adherent thin films via cost-effective, scalable, environmentally benign process has potential technological benefits. Sputtering process parameters were optimized on DC cylindrical rotating magnetron system to obtain stress free, conductive, well adherent and uniform Mo thin films on substrates of size 300 mm x 300 mm for contact applications.

Key Features

- Mo thin films of 500 nm thickness using rotating DC magnetron on SLG substrate of the size of 300 mm x 300 mm
- High uniformity of thickness (Std. Dev. 3.17%), best electrical (resistivity of 1.59E-05 Ω.cm), mechanical and optical properties of Mo thin film over large area.
- High reflectance in IR region
- High adhesion strength on Mo to glass substrate



FESEM X-Section image of Mo thin film on glass

Potential Applications

- Solar energy
- Electrical and electronics
- Sensor

Properties of Mo thin film on glass	Achieved
Thickness	500 nm
Uniformity (std. dev)	3.17 %
Resistivity	1.59E-5 Ω.cm
Reflectance	65%
Adhesion test (ASTM D3359)	Passed

Summary of best achieved properties of Mo thin film on glass

Present Status

- Application development completed

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. Molybdenum bilayer thin film on large area by cylindrical rotating DC magnetron sputtering for CIGS solar cell application, Amol C. Badgujar, Brijesh Singh Yadav, Suhash R Dey, Rajiv O. Dusane and Sanjay R. Dhage* *Proceedings of 35th EUPVSEC 2018*
2. Effect of various surface treatments on adhesion strength of magnetron sputtered bi-layer molybdenum thin films on soda lime glass substrate, B.S.Yadav, Amol C. Badgujar and Sanjay R. Dhage*, *Solar Energy* 157 (2017) 507-513
3. Process parameter impact on properties of sputtered large-area Mo bilayers for CIGS thin film solar cell applications, Amol C. Badgujar, Sanjay R. Dhage*, and Shrikant V. Joshi, *Thin Solid films* 589 (2015) 79-84

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