PRESS RELEASE

IIT Mandi Researchers Develop a Cost-effective Method for Producing Metal Oxide Layers for Solar Cells

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Video Byte – https://drive.google.com/drive/u/1/folders/1w1CzZPn65zJ6bomUjwYVXYD6vQ_YyqGN

Mandi, 20th March 2023: Researchers at the Indian Institute of Technology Mandi have made a significant breakthrough in the development of metal oxide layers for use in advanced architecture silicon solar cells.

The results of this work is published in the journal of Materials Science: Materials in Electronics, co-authored by Dr Kunal Ghosh, Associate *Professor*, School of Computing and Electrical Engineering, IIT Mandi and his Ph.D scholars Mr. Syed Mohd Hussain and Mr. Md Sadullah from IIT Mandi.

Metal oxides such as nickel oxide, are an important class of semiconductors used in advanced architecture silicon solar cells. Nickel oxide films with thicknesses in the nanometre range – a hundred thousand times smaller than the width of a single human hair – must be produced for this purpose. The current methods for developing nanometric thin films of nickel oxide are prohibitively expensive, as the equipment required for production has to be imported. Additionally, the precursors used for the development of the films, such as nickel acetylacetonate, are also expensive, making it less likely for such technology to be commercially viable.

Researchers at IIT Mandi have developed a low-cost process to produce ultrathin films of metal oxides from cheaper starting materials. Specifically, they used aerosol-assisted chemical vapour deposition technique to deposit nickel oxides thin film on silicon substrate.

Explaining the process, Dr Kunal Ghosh, IIT Mandi, said, *“Aerosol-assisted chemical vapor deposition is a technique used to produce high-quality, uniform thin films on various surfaces, including silicon, by delivering a vapor phase precursor in the form of an aerosol. The aerosol enables the deposition of a wide range of oxide based materials with high precision, making it a versatile and cost-effective method for various applications in materials science and engineering.”*

The team used nickel nitrate to produce Nickel oxide films with a thickness of approximately 15 nanometres. They analysed the morphology and composition of the nickel oxide films produced using various characterization techniques. They also analyzed the diode characteristics of the deposited thin film on the silicon substrate and found it to have properties suited for fabrication of solar cells.

Presently, the project is at Technology Readiness Level (TRL) 3, which means that it is still in the early stages of development. However, with further development and increased TRL, this technology has the potential to be adopted by the industry. This research will enhance the fabrication process of advanced architecture silicon photovoltaic devices, reducing the cost and complexity of commercial techniques.

Dr. Kunal Ghosh, who led the research team, commented on the significance of the breakthrough, saying, "*Our research shows that it is possible to develop a cost-effective and scalable process for the production of metal oxide layers for solar cells. This new method has the potential to revolutionize the solar industry by reducing the cost and complexity of current production techniques. Additionally, as the whole process including the equipment is developed in-house, the generated IP will contribute towards ATMANIRBHARTA in the area of advanced architecture silicon solar cells.*"

India currently has a manufacturing capacity of 3GW for solar cells and 15GW for modules. However, the government plans to create an additional domestic solar equipment manufacturing capacity of 25 gigawatts (GW) each of solar cells and modules, and 10GW of wafers by April 2023, making research such as this crucial for India's solar industry.

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About IIT Mandi

IIT Mandi has nine Academic Schools and five major Research Centers. The Schools are the School of Biosciences and Bioengineering (SBBE), School of Chemical Sciences (SCS), School of Mathematical and Statistical Sciences (SMSS), School of Physical Sciences (SPS), School of

Mechanical and Materials Engineering (SMME), School of Civil and Environmental Engineering (SCENE), School of Computing and Electrical Engineering (SCEE), School of Humanities and Social Sciences (SHSS), and School of Management (SOM). The Centers are Advanced Materials Research Centre (AMRC), Centre for Design and Fabrication of Electrical Devices (C4DFED), BioX Centre, Indian Knowledge System and Mental Health Applications Centre (IKSMHA Centre) and Centre for Artificial Intelligence and Robotics.

The Institute offers B.Tech. programs in seven different streams, one M.A. program, ten M.Tech. programs, nine Ph.D. programs, and one iPh.D. program. The unique, project-oriented B.Tech. curriculum is centered around its 4-year long Design and Innovation stream. Since the inception of the Institute, IIT Mandi faculty have been involved in over 275 Research and Development (R&D) projects worth more than Rs. 120 crores.

IIT Mandi established the IIT Mandi iHub and HCI Foundation (iHub; a section-8 company) on its campus at Kamand with significant funding of INR 110 crores from the Department of Science and Technology (DST), Government of India. The iHub is planned to fuel research and technology development, skill development, startup and innovation, and collaborations in the HCI and allied AI/ML areas in India. IIT Mandi is the only second-generation IIT to be featured at rank 7 in the Atal Ranking of Institutions on Innovation Achievements of the Innovation Cell, Ministry of Education, Govt. of India.

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