



IEST, Shibpur



Department of  
Science &  
Technology,  
Government of  
India

सत्यमेव जयते  
DST, Govt. of India



IIT (ISM) Dhanbad

# Report:

One-Week Hands-On Training Program

On

**“Fabrication and Characterization of Advanced Photovoltaic Devices”**

Under

**Synergistic Training program Utilizing the Scientific & Technological Infrastructure**

An initiative of Department of Science & Technology (DST), Govt. Of India

Organized by

Department of Physics, IEST Shibpur

In association with

Indian Institute of Technology (Indian School of Mines) Dhanbad

*Sagar*  
02/02/23

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*Shashiendra*  
01.02.23

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**One-Week Hands-On Training program on "Fabrication and Characterization of Advanced Photovoltaic Devices" (12<sup>th</sup> Dec -18<sup>th</sup> July, 2022)**

The Department of Science and Technology, Government of India, has given the responsibility to IIT (ISM) Dhanbad to build human resources and its knowledge capacity using open access science and technology infrastructure through the scheme "*Synergistic Training Program Utilizing the Scientific and Technological Infrastructure (STUTI)*". Thus, under DST-STUTI programme of IIT (ISM) Dhanbad, a one-week hands-on training program on "*Fabrication and Characterization of Advanced Photovoltaic Devices*" was organized from 12<sup>th</sup> Dec to 18<sup>th</sup> Dec, 2022 at Department of Physics, IEST Shibpur, West Bengal.

This training program was coordinated by Dr. Syed Minhaz Hossain, Department of Physics, IEST Shibpur and Prof. S. K. Sharma, Department of Applied Physics, IIT (ISM) Dhanbad. This program includes thirty participants (Faculty/Research Scholar) from various Universities/Colleges/Institute in India, with no more than three from the same Universities/Colleges/Institute.

**Highlights of the Day-1 (Dated: 12<sup>th</sup> Dec, 2022)**

The first day of the training program began with a brief introduction to the program's purpose and significance by Dean (R & C), IEST Shibpur. The introduction energized the participants' interest in science and engineering. Next, the training program was inaugurated by Prof. Parthasarathi Chakrabarti, Director, IEST Shibpur. Then, an overview of the DST-STUTI program was given by Dr. S.K. Sharma, Program Coordinator, IIT (ISM) Dhanbad. The participants were then given a welcome kit that included a note pad, a power kit (pen, pencil, eraser, and sharpener), and a program pamphlet.

Following that, two consecutive lectures were scheduled, with a relatively short tea break in between. Solar Photovoltaics was the basis for the first lecture. The first lecture (from 10:30 AM to 12:00 PM) was delivered by Dr. Syed. Minhaz Hossain, HoD, Department of Physics, IEST Shibpur, on Potential of Si- nano crystal as hot carrier absorber and the second lecture (from 12:00 PM to 01:30 PM) was delivered by Dr. Ujjwal Bhattacharya, Department of Chemistry, IEST, Shibpur on Time resolved photoluminescence spectroscopy and Time correlated photon counting technique.

Shajendra

Sagar

Piyush



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Next, after the lunch break, a practical demonstration (from 02:15 PM to 05:15 PM) on PECVD, E-beam and RF sputtering, was provided.

### Highlights of the Day-2 (Dated: 13<sup>th</sup>Dec, 2022)

On the second day, two lectures were given based on Luminescent materials as solar spectral converter for photonics application and Colloidal quantum Dot solar cells and XRD Rietveld Refinement Rules. The first lecture (from 10:30 AM to 12:00 PM) was delivered by Prof. Shailendra Kumar Sharma Department of Applied Physics, IIT (ISM) Dhanbad, and the second lecture (from 12:00 PM to 01:30 PM) was delivered by Prof. R. Thangavel, IIT (ISM) Dhanbad.

Next, after the lunch break, a practical demonstration (from 02:15 PM to 05:15 PM) on Powder X-Ray Diffraction (PXRD) was provided.

### Highlights of the Day-3 (Dated: 14<sup>th</sup>Dec, 2022)

Similarly, on the third day, two lectures were conducted. Solar Photovoltaics: Industrial perspectives was the prime focus of these lectures. The first lecture (from 10:30 AM to 12:00 PM) was delivered by Dr. Kanak Mukherjee, M.D, Agni Green Limited, Kolkata, and the second lecture (from 12:00 PM to 01:30 PM) was focused on Photovoltaic module technologies and reliabilities issues delivered by Dr. Santanu Maity, Assistant Professor, (SAMGESS) IEST, Shibpur

Following the lunch break, a practical demonstration (from 02:15 PM to 05:15 PM) on Photo Luminescence (PL) was provided.

### Highlights of the Day-4 (Dated: 15<sup>th</sup>Dec, 2022)

On the fourth day, two lectures were given based Semiconductor for clean energy generation and storage, and Quantum well solar cell. The first lecture (from 10:30 AM to 12:00 PM) was delivered by Dr. Nillohit Mukherjee, Assistant Professor, (SAMGESS), IEST Shibpur, and the second lecture (from 12:00 PM to 01:30 PM) was delivered by Prof. Sanatan Chattopadhyay, Department of Electronic Science, Calcutta University.

Next, after the lunch break, a practical demonstration (from 02:15 PM to 05:15 PM) on the Solar cell parameters measurement was provided.

*Shailendra*

*Sagar 02/02/23*

*(Signature)*

### Highlights of the Day-5 (Dated: 16<sup>th</sup>Dec, 2022)

Similarly, on the fifth day, two lectures were conducted. Fabrication of crystalline silicon solar cell and CdS based thin film solar cell were the prime focus of these lectures. The first lecture (from 10:30 AM to 12:00 PM) was delivered by Dr. Gaurab Das, Green Energy Center, IEST Shibpur and the second lecture (from 12:00 PM to 01:30 PM) was delivered by Prof. Anup Mandal, Retired Professor, Dept. of Chemistry, IEST Shibpur.

Next, after the lunch break, a practical demonstration (from 02:15 PM to 05:15 PM) on thin film solar cell

### Highlights of the Day-6 (Dated: 17<sup>th</sup>Dec, 2022)

On the sixth day, two lectures were given based on Self-Cleaning of solar panels wet and dry and Organic & perovskite materials based thin film solar cell. The first lecture (from 10:30 AM to 12:00 PM) was delivered by Dr. R. Bhattacharya, Scientist – G, Retired from NPL, New Delhi and the second lecture (from 12:00 PM to 01:30 PM) was delivered by Prof. Partha Pratim Ray, Dept. of Physics, Jadavpur University.

Next, after the lunch break, a laboratory demonstration (from 02:15 PM to 05:15 PM) on Self Cleaning of solar panels wet and dry was provided.

### Highlights of the Day-7 (Dated: 18<sup>th</sup>Dec, 2022)

Similarly, on the seventh day (the last day of the training program), two lectures were conducted. Introduction to X-Ray scattering & DLS to characterize thin films and particle size and Fabrication of Advanced c-Si Solar Cell were the prime focus of these lectures. The first lecture (from 10:30 AM to 12:00 PM) was delivered by Dr. Mojammel Haque Mondal, Dept. of Physics, IEST Shibpur, and the second lecture (from 12:00 PM to 01:30 PM) was delivered by Dr. Nabin Chandra Mandal, SAMGESS, IEST Shibpur.

Next, after the lunch break, a practical demonstration (from 02:15 PM to 05:15 PM) on samgess was provided.

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Following that, the certificate distribution took place, followed by a closing speech by Prof H Saha, an eminent scientist and one of the pioneer in the field of silicon photovoltaics in India. Throughout the training programme, a formal discussion environment was established for the exchange of scientific and technological knowledge.

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