



भारतीय प्रौद्योगिकी संस्थान गुवाहाटी  
Indian Institute of Technology Guwahati  
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# विज्ञानवर्ति

The Monthly Newsletter of IIT Guwahati  
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Photo: Prof. Chandan Mahanta

## IIT Guwahati Researchers develop Smart Window Materials for Automatic Climate Control of Buildings

Indian Institute of Technology Guwahati (IIT Guwahati) researchers have developed smart window materials for automatic climate control of buildings. Dr. Debabrata Sikdar, Assistant Professor, Department of Electronics and Electrical Engineering, along with his research scholar, Mr. Ashish Kumar Chowdhary from IIT Guwahati, have designed a smart window material that can effectively control the amount of heat and light passing through it in response to an applied voltage. Such smart window materials would help developing efficient automatic climate control systems in buildings. The results of their study have recently been published in the journal, *Solar Energy Materials and Solar Cells*.

According to the United Nations Environment Program, buildings around the globe account for 36 percent of energy use and 39 percent of energy-related carbon dioxide emissions annually. The primary consumption of energy in buildings is by the climate control system, in which energy-consuming devices are used to maintain comfortable indoor temperature and brightness. Hence, a building's heating, cooling, and lighting loads are major energy-consumption segments in any building. To meet the goals of the

Paris Climate Agreement, a building's energy intensity – how much energy buildings use – will have to improve by 30 percent by 2030.

“There has been increased attention to sustainable architectural designs for better light and heat management in buildings in recent years, and deploying smart windows is the first step for such structures”, said Dr. Debabrata Sikdar, Assistant Professor, Department of Electronics and Electrical Engineering, IIT Guwahati. Conventionally, window designs are static, i.e., they are pre-designed for specific climatic conditions. The emergent smart windows, on the other hand, can dynamically adjust the amount of light and heat radiation entering a building in response to external stimuli, thus conserving the building's energy.

The design of smart windows that are tuneable for all-weather conditions is challenging. The IIT Guwahati team has designed smart window ‘glasses’ using noble metals as well as their relatively inexpensive alternatives that can dynamically control the intensity of transmitted solar radiation, depending upon the weather/climate condition.

"We have proposed an electro-tuneable glass made of two ultra-thin metal layers sandwiching an electro-optic polymer whose refractive index can be changed by applying a small voltage, which allows filtering of visible and infrared radiation," explained Mr. Mr. Ashish Kumar Chowdhary, Research Scholar, IIT Guwahati.

The researchers used this design to perform simulation studies to understand the light and heat transmission properties in response to the applied voltage. They initially considered gold and silver as the metal layers, but later tested their model with cheaper alternatives such as copper, and transparent semiconductor such as indium tin oxide.

When the researchers simulated the application of a bias voltage ranging from  $-15\text{ V}$  to  $+15\text{ V}$  across this sandwich structure using Finite Element Methods, the smart glass could selectively filter solar radiation, spanning the visible, infrared and shortwave infrared wavelengths. Simulation also showed that this material reflected mid-wave infrared, long-wave infrared (LWIR;  $8\text{--}15\ \mu\text{m}$ ), and a part of far-infrared wavelengths thereby providing insulation from heat and light reflected from neighbouring buildings and structures.

"At present, the COVID-19 pandemic has imposed an unprecedented risk of cross-infections through aerosols transmission in public buildings such as health-care centres, offices, transportation systems, workshops, laboratories and food storage facilities etc., where central air-conditioning systems are in use. We believe that our smart windows can provide an alternative solution for maintaining ambient indoor temperature and lighting inside a building or a vehicle by integrating those with usual glass windows or walls, thereby reducing the need of air-conditioning systems" said Dr. Debabrata Sikdar.

These smart glasses can find applications for efficient automatic climate control in vehicles, locomotives, airplanes and greenhouses of the future. The smart glass material proposed by the IIT Guwahati team can easily be fabricated using existing state-of-the-art nanoscale fabrication methods such as e-beam evaporation and graphoepitaxy techniques. The researchers acknowledge that since the optical response of these types of smart glasses is critically linked to the surface smoothness and other physical properties of the layers, it is important to further analyse the effect of these properties on the performance of the glass. The team plans to study these areas in future.

### Sikdar Nanoplasmonic Research Group



Dr. Debabrata Sikdar  
(Supervisor)



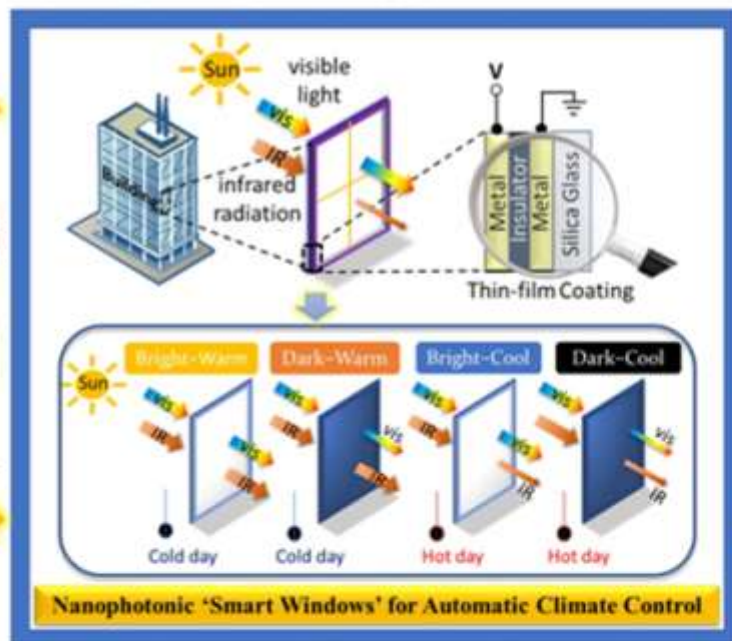
Vehicles with Switchable Windows



Smart glasses for Greenhouses



Mr. Ashish Kumar Chowdhary  
(Ph. D. Student)



Dimmable Windows in airplanes



Smart windows for railway coaches



## Awards & honours



Prof. P K Giri of Dept. of Physics has been awarded Fellowship of IOP, UK, which provides an opportunity to connect with like-minded people, attend engaging events, give back through mentoring and outreach initiatives, and enhance professional development



Dr. Biranchi Panda, Assistant Professor in Department of Mechanical Engineering has joined as Editorial Board Member of Scientific Reports. The journal has an inclusive and multidisciplinary ethos, and currently publishes research from all areas of the

natural and clinical sciences and now expanding the scope to include engineering disciplines.

## Obituary



Murari Jha  
BTech (2013-2017)

We regret to inform the sudden demise of Murari Jha, a 2017 BTech graduate from the Department of Bioscience & Bio-engineering. He passed away of 14 May 2021 after fighting with COVID for two long weeks.

We pray that Murari Jha finds eternal peace and hope his family finds the strength in these difficult times.

## 1<sup>st</sup> International Seminar on Stainless Steel Structures concluded

IIT Guwahati organised the 1st International Seminar on Stainless Steel Structures (iS4 2021), on 27 May 2021. Due to the ongoing pandemic the seminar was held online.

Over 300 participants, from 18 countries (UK, US, Australia, Germany, New Zealand, China, South Korea, India, Japan, Singapore, Brazil, Columbia, Turkey, Egypt, Ghana, Malaysia, Philippines, and Czech Republic), Faculty members, Industry representatives, Engineers and students have participated in the said seminar.

Prof. T. G. Sitharam, Director, IIT Guwahati in his welcome address said, 'across the world there is an increasing demand for steel structures because of its many advantages. The use of stainless steel is a promising alternative as a construction material for civil engineering'.

Prof. Leroy Gardner from Imperial College London, the main speaker, delivered a technical talk on the topic 'Stainless Steel Structures - Stability and Design'.

Prof. Gardener said, 'selecting the right (stainless steel) grade is really crucial and if you select the right grade, then it should have an extremely long design life, requiring very little maintenance'

Apart from the various gamut of design and analysis of Stainless Steel Structural members, Prof. Gardner also spoke about Advanced Analysis Method and 3D printing of structures.

Organiser of the seminar, Prof. Konjengbam Darunkumar Singh of IIT Guwahati, added 'The International seminar on Stainless steel structures is an initiative to introduce and popularize the uses of stainless steel structures in the construction industry. Its (iS4) chief aim is to bring together all the stakeholders and to provide a platform or an opportunity to share technical / research advancements (associated with Stainless Steel structures)'

One of the attendees from an Indian construction industry, Jayesh, found the seminar session very informative and knowledgeable.



Prof. Luciano Lima from Brazil, congratulated the entire team for their efforts in organizing the seminar and specially appreciated that the presentation by Prof. Gardner.

A PhD student, Ms. Yamin Wang, from Australia, and many of the attendees from the Indian construction industry observed the seminar to be very informative.

## Stainless Steel Structures – Stability And Design

### 1<sup>st</sup> International Seminar On Stainless Steel Structures



**INTRODUCTORY REMARK**

**TG Sitharam,**  
FASCE, FICE  
DIRECTOR  
IIT GUWAHATI



**SPEAKER**

**Leroy Gardner,**  
FREng, FICE, FISTRUCTE  
IMPERIAL COLLEGE  
LONDON



**is<sup>4</sup>**  
**2021**



**Imperial College  
London**

**Date:** 27<sup>th</sup> May, 2021 (Thursday)  
**Time:** 10 AM (UK), 2:30 PM (India), 5:00 PM (Hong Kong)

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**ORGANISER**

**Konjengbam Darunkumar Singh, nce**  
IIT GUWAHATI

**JOIN Event**  **Airmeet** [tinyurl.com/is4airmeet](https://tinyurl.com/is4airmeet) **Watch LIVE**  [tinyurl.com/is4youtube](https://tinyurl.com/is4youtube)



Prime Minister's Research Fellows (PMRF) Award



SHEJULE PRIYA ASHOK  
Civil Engineering



MADHUSMITA NANDA  
Civil Engineering



SUBHRAJYOTI GHOSH  
Chemistry



SHEHNAZDEEP  
Civil Engineering



NADAF ARMAN MOHADDIN  
Mechanical Engineering



PRIYAM GHOSH  
Chemistry



SATYAM PANDA  
Civil Engineering



ASHRUTI UPADHYAYA  
Electronics & Electrical Engineering



ABHISKEK SARKAR  
Chemistry



ARNAB BANERJEE  
Civil Engineering



AVIRAL KUMAR  
Bioscience and Bioengineering



MITHU ROY  
Chemistry



BODDEPALLI UDAY  
Civil Engineering



KALPANA KUMARI  
Bioscience and Bioengineering



SOUMALAYA BHOWMIK  
Nanotechnology



ANURAG HANDIQUE  
Civil Engineering



PRADEEP KUMAR SUNDARAVADIVELU  
Bioscience and Bioengineering



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