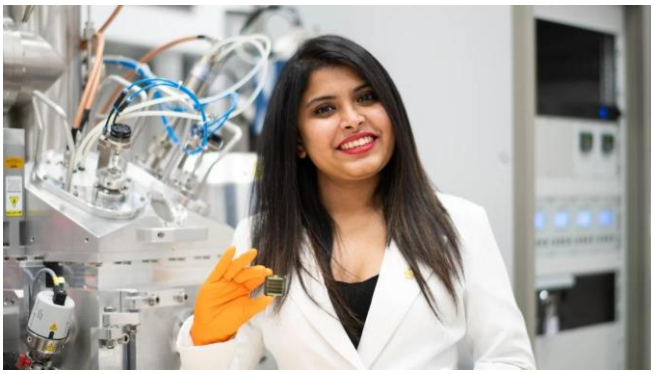
June 2025

Advanced Technology Institute Newsletter
Faculty of Engineering and Physical Sciences

News

SCIENTISTS CRACK THE CODE TO LONGER-LASTING PEROVSKITE SOLAR TECHNOLOGY

Perovskite solar cells could last ten times longer thanks to new research led by the University of Surrey, which suggests alumina (Al_2O_3) nanoparticles significantly enhance the lifespan and stability of these high-efficiency energy devices.



Dr Hashini Perera, postgraduate research student at the University of Surrey's Advanced Technology Institute and lead author of the study

While perovskite solar cells offer a cost-effective and lightweight alternative to traditional silicon-based technology, their commercial potential has been limited due to a flaw in their structure – primarily caused by iodine leakage. Over time, this escape of iodine can lead to material degradation, reducing performance and durability.

Working in collaboration with the National Physical Laboratory and the University of Sheffield, scientists have now discovered a way to trap iodine by embedding tiny particles of Al_2O_3 – aluminium oxide – within the cell, holding promise for longer-lasting and more affordable next-generation solar panels.

The study, published in EES Solar, tested the modified solar cells under extreme heat and humidity to replicate real-world conditions. Results showed that solar cells with embedded Al_2O_3 nanoparticles maintained high performance for more than two months (1,530 hours) – a tenfold improvement compared to just 160 hours without the alumina-enhanced modifications.

Further analysis revealed that the Al_2O_3 nanoparticles contributed to a more uniform perovskite structure, reducing defects and improving electrical conductivity; it also formed a protective 2D perovskite layer, which acts as an additional barrier against moisture degradation.

It's incredibly exciting to see our approach make such an impact. A decade ago, the idea of perovskite solar cells lasting this long under real-world conditions seemed out of reach. With these improvements, we're breaking new ground in stability and performance, bringing perovskite technology closer to becoming a mainstream energy solution."
- Dr Hashini Perera

IN THIS ISSUE

STICKING TO THE STATUS QUO ON ENERGY POLICY WOULD BE "FOOLISH"

Comment from Professor Ravi Silva, Interim Director of the Institute for Sustainability

Professor Ravi Silva

"Investing in renewable energy is not just an environmental necessity – but it's the logical strategic move for economic stability and energy security. The turbulence caused by the war in Ukraine and geopolitical tensions with Russia has exposed the UK's vulnerability to volatile fossil fuel markets, driving energy prices to record highs and putting immense pressure on households and businesses. Reducing our reliance on imported gas and oil is critical to ensuring long-term price stability and energy independence. Frankly, keeping the energy policy status quo would be foolish on the part of the UK.

Wind and solar power are now among the cheapest sources of energy, with costs continuing to decline. By expanding renewable capacity alongside energy storage and smart grid technology, we can build a more reliable and cost-efficient energy system. This transition isn't about increasing costs–it's about long-term savings. A well-planned shift to Net Zero can lower energy bills, protect consumers from future price shocks, and create a more resilient economy."

GM'S 'NEXT-GEN' EV BATTERIES SHOW PROMISE – BUT KEY HURDLES REMAIN

Comment from Dr Kai Yang, Lecturer in Energy Materials & Nanotechnology at the University of Surrey

"Lithium manganese-rich (LMR) cathodes offer much higher energy density than current Nickel Cobalt Aluminium Oxide (NCA), Nickel Cobalt Manganese Oxide (NCM), and Lithium Iron Phosphate (LFP) batteries, while reducing reliance on expensive cobalt, making them a strong candidate for next-generation electric vehicles (EVs). However, their high-voltage operation triggers oxygen release, leading to structural degradation, electrolyte decomposition, voltage fade, and reduced energy/power density. These issues not only limit battery health but also raise safety concerns.

Dr Kai Yang

While advances in material design are promising, wide adoption will also depend on intelligent battery sensing to monitor degradation in real time and ensure safe, stable operation. A 2028 rollout is possible in niche markets, but broader use requires further breakthroughs in stability and interfacial-related issues."

PHD GRADUATION CEREMONY 2025

Dinesha Priyadarshani, Shashini Silva, Hashini Perera

On **Wednesday, 30th April 2025**, we proudly celebrated the remarkable achievements of our PhD graduates at a memorable Graduation Ceremony, followed by a Graduation Reception in the ATI lobby. Surrounded by family, friends, mentors, and faculty, our newest doctors were honoured for their dedication, resilience, and significant contributions to research and knowledge.

Here's to a group of remarkable individuals who've demonstrated resilience, collaboration, and a passion for discovery that inspires us all.

Congratulations to our 2025 graduates – we are incredibly proud of you!

Upcoming Events

We are pleased to announce the **UK-India Advanced Semiconductor Materials Forum for Sustainable Technologies**, which will take place in the UK on the **30th of June and the 1st of July** at the **University of Surrey.**

The conference will bring together leading experts, researchers, and professionals in the field of semiconductors to explore new opportunities for fostering sustainable technologies.

The event will feature insightful presentations and discussions on the latest innovations in semiconductor research, industry applications, and their potential to drive sustainability. It will cover key topics such as:

- Advanced Semiconductor Materials and Nanostructures
- 2D Materials – Transition Metal Dichalcogenides (TMDs)
- Organics, Hybrids & Perovskites
- Wide Bandgap Semiconductors
- Critical Materials and the Circular Economy

For more information and for registration, check out our website.

Staff News

ATI and **IBC** welcome **Miss Natasha Clifton** as the new **ATI Centre Administrator**.

Best wishes to **Dr Keith Heasman** and **Dr David Cox** who have both retired.

Congratulations to **Professor Ravi Silva** for becoming the **Interim Director** for the **Institute for Sustainability**.

PhD News

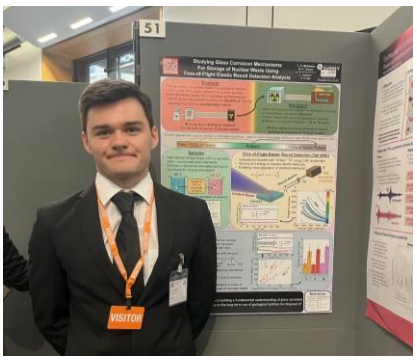
The **Ion Beam Centre** was delighted to welcome **Sraboni Dey** and **Vipin Yadav**, PhD students from the Indian Institute of Science Education and Research Thiruvananthapuram, for short-term visiting positions.

Sraboni Dey

Sraboni was working on Ion implantation of 2D materials for photonic applications.

Vipin's research focused on 2D materials and their functionalisation for supercapacitors and battery applications. He explored ion beam modification to fine-tune the properties of these materials.

Vipin Yadav



Callum McAleese

Post graduate researcher, **Callum McAleese**, was selected by the Parliamentary and Scientific Committee to present a poster about his research at the prestigious STEM for BRITAIN event, which took place in the Houses of Parliament on March 11.

His work on using ion beams to analyse glass corrosion and addressing long-term stability sounds incredibly important, especially for tackling challenges related to nuclear waste and promoting a circular economy.

ATI Viva voce examinations in 2025

Our research students who have passed their PhD viva voce examinations in 2025

Dr Gianluc Romulus Lui (Supervisors: Prof Marian Florescu, Dr Izabela Jurewicz)
Project: Photonic Band Gaps in Ordered and Disordered Materials: Fundamentals and Applications

Dr Surajit Kar (Supervisors: Dr Yunlong Zhao, Prof Ravi Silva, Prof John Joe McFadden)
Project: Free-Standing Microelectrode Probes for High-Resolution Interrogation of Living Cells

Dr Patryk Golec (Supervisors: Dr Radu Sporea, Prof Marian Florescu)
Project: Compact Modelling of Source Gated and Multimodal Thin Film Transistors

Dr Shaoyin Li (Supervisors: Prof Qiong Cai, Dr Tan Sui)
Project: UV-Micro-Patternable Ionogel Electrolytes: Design, Preparation, and Applications in Energy Storage Devices