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Surrey Uni on space mission to darken the skies

More than 8,000 low Earth orbit (LEO) satellites already orbit Earth, and projections estimate a rise to 60,000 by 2030, partly driven by the development of mega-constellations. The rate of growth means the issue of light reflecting from satellites back to Earth is pressing for astronomers and stargazers, as images from the Vera C Rubin Observatory in Chile have highlighted.

To combat this problem, satellite operators have begun experimenting with mitigation strategies, including dark coatings and changes to satellite position, though the negative impact on ground-based measurement persists. Surrey NanoSystems, with a heritage in ultra-black technologies, have developed an innovative new solution: Vantablack 310 is a handleable, customer-applied coating, resistant to the challenging LEO environment.

The technology will be trialled on Jovian 1, the first satellite mission from JUPITER – the Joint Universities Programme for In-Orbit Training, Education and Research. The mission, scheduled to launch in 2026, will carry payloads from the Universities of Surrey, Portsmouth and Southampton, AMSAT-UK, and one designed, built and tested by students from the three universities, giving them invaluable hands-on space industry experience.

One side of the shoebox-sized CubeSat will be coated with Vantablack 310, marking the first UK-led initiative to explore solutions for reducing satellite brightness. The initiative aims to not only improve space sustainability but also demonstrate the efficacy of Vantablack 310 as a hull-darkening solution. Researchers from the University of Surrey are developing ways to evaluate the experiment from Earth.

Dr Keiran Clifford, Senior Technologist and project lead at Surrey Nanosystems, said:

“The proliferation of satellite constellations is expected to bring huge societal benefits in technology areas, including global communication and remote sensing. Unfortunately, the current brightness of these satellites severely disrupts ground-based astronomy.

“Our latest coating technology, Vantablack 310, offers super-black performance across a wide range of viewing angles, while remaining robust to the challenging LEO environment. We’re proud to be working with our partners at the University of Surrey to deliver innovations in the satellite sector, ensuring sustainable and equitable access to a night sky for all.”

Astha Astha, the postgraduate astrophysics researcher at the University of Surrey who will develop tests to measure how much Vantablack 310 reduces light pollution when viewed from Earth, said:

“Studies show that satellite mega-constellations could increase sky brightness by up to 1% in the worst-affected regions, posing a serious threat to astronomical observations and dark sky preservation. Our project directly tackles that challenge by exploring innovative ways to reduce satellite reflectance. It brings together key areas of Surrey’s expertise — astrophysics, space engineering, and nanotechnology — with Surrey NanoSystems, which itself spun out of the University’s Advanced Technology Institute.”

The relationship between Surrey NanoSystems and the University of Surrey is deeply rooted in research and innovation. As a spinout company in 2006, Surrey NanoSystems leveraged the University’s expertise in nanomaterials and advanced manufacturing techniques to develop its groundbreaking Vantablack® technologies.

Image: Artist’s impression of a large satellite constellation in low Earth orbit circling above the LOFAR telescope. Credit: International Astronomical Union Creative Commons Attribution 4.0 International

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Surrey battery leads

Scientists at the University of Surrey have made a breakthrough in eco-friendly batteries that not only store more energy but could also help tackle greenhouse gas emissions. Lithium–CO_2 ‘breathing’ batteries release power while capturing carbon dioxide, offering a greener alternative that may one day outperform today’s lithium-ion batteries.

Until now, Lithium-CO_2 batteries have faced setbacks in efficiency – wearing out quickly, failing to recharge and relying on expensive rare materials such as platinum. However, researchers from Surrey have found a way to overcome these issues by using a low-cost catalyst called caesium phosphomolybdate (CPM). Using computer modelling and lab experiments, tests showed this simple change allowed the battery to store significantly more energy, charge with far less power and run for over 100 cycles.

The study, published in Advanced Science, marks a promising step toward real-world applications. If commercialised, these

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batteries could help cut emissions from vehicles and industrial sources – and scientists even imagine they could operate on Mars, where the atmosphere is 95% CO_2.

Dr Siddharth Gadkari, Lecturer in Chemical Process Engineering at the University of Surrey, and corresponding author of the study, said:

“There’s a growing need for energy storage solutions that support our push toward renewable power while also tackling the growing threat of climate change. Our work on lithium–CO_2 batteries is a potential game-changer in making that vision a reality.

“One of the biggest challenges with these batteries is something called ‘overpotential’ – the extra energy needed to get the reaction going. You can think of it like cycling uphill before you can coast. What we’ve shown is that CPM flattens that hill, meaning the battery loses far less energy during each charge and discharge.”

To understand why the CPM worked so well, teams from Surrey’s School of Chemistry and Chemical Engineering and the Advanced Technology Institute used two approaches. First, they dismantled the battery after charging and discharging to study the chemical changes inside. These post-mortem tests found that lithium carbonate, the compound formed when the battery absorbs CO_2, could be reliably built up and removed – an essential feature for long-term use.

They then turned to computer modelling using density functional theory (DFT), which allows researchers to explore how the reactions unfold on the material surface. Results showed how the CPM’s stable, porous structure offered the ideal surface for key chemical reactions.

Dr Daniel Commandeur, Future Fellow at the University of Surrey and corresponding author of the study, said:

“What’s exciting about this discovery is that it combines strong performance with simplicity. We’ve shown that it’s possible to build efficient lithium–CO_2 batteries using affordable, scalable materials – no rare metals required. Our findings also open the door to designing even better catalysts in the future.”

The discovery opens new doors for developing even better low-cost, easy-to-make battery materials. With further research into how these catalysts interact with electrodes and electrolytes, lithium–CO_2 batteries could become a practical, scalable way to store clean energy, while helping reduce carbon in the atmosphere.

Yes to chocolate, tea, apples and grapes

We might have another reason to enjoy our daily cup of tea or small piece of dark chocolate, as a new study from the University of Surrey has found that naturally occurring compounds called flavan-3-ols – found in cocoa, tea, apples and grapes – may improve blood pressure and the health of our blood vessels.

The research, published in the European Journal of Preventive Cardiology, analysed data from 145 randomised controlled studies, and found that regular consumption of flavan-3-ols can lead to a reduction in blood pressure readings, particularly in people with elevated or high blood pressure. In some cases, the average blood pressure-lowering effects were comparable to those seen with some medications.

Flavan-3-ols were also found to improve the function of the endothelium – the inner lining of blood vessels – which is crucial for overall cardiovascular health. This improvement occurred independently of blood pressure changes, suggesting a broader positive impact on the circulatory system.

Professor Christian Heiss, lead-author of the study and Professor of Cardiovascular Medicine at the University of Surrey, said:

“The findings are encouraging for those looking for accessible ways to manage their blood pressure and support their heart health through enjoyable dietary changes. Incorporating small amounts of commonly consumed foods like tea, apples, dark chocolate, or cocoa powder into a daily balanced diet could provide beneficial amounts of flavan-3-ols.

“While not a replacement for prescribed medications or medical advice, including more flavan-3-ol-rich foods in a daily routine could be a valuable addition to a healthy lifestyle, especially for those with higher blood pressure. These are findings that, although promising, require ongoing investigation.”

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Surrey Uni knows the display way to San Jose

A radical new approach to display screen technology could halve production costs, reduce harmful waste, and deliver brighter, more energy-efficient screens for our smartphones, smartwatches, and even certain medical devices, say researchers at the University of Surrey.

Most display screens use complex circuits made up of tiny switches called thin-film transistors (TFTs), which control when each pixel turns on or off and how bright it should be. However, building these circuits requires a lot of time, energy, water and harsh chemicals, making the manufacturing process expensive and resource-heavy.

At this year's Display Week 2025 Technical Symposium in San Jose, California (11-16 May), Dr Radu Sporea and Dr Eva Bestelink will unveil their latest research, based on a new type of electronic component called a multimodal transistor (MMT). Originally designed as a hardware AI computing element, the MMT also has the ability to simplify display circuits while improving performance and sustainability.

Dr Radu Sporea, Associate Professor in Semiconductor Devices at the University of Surrey, said:

"Our invention challenges decades of industry practice by embracing properties usually seen as flaws. In most displays, engineers try to eliminate the energy barriers that form where metals meet semiconductors because they restrict current flow. But instead of working around them, we've made those barriers central to how our transistors operate.

"Using these effects deliberately, we've shown that the electronic circuits at the heart of display screens can be made with fewer components and processing steps – reducing waste, cutting costs and improving performance. And because it works with existing materials and tools, it's a smarter, more sustainable upgrade for the screens we use every day. For the user, the reduced power requirements in operation will also mean significantly improved battery life."

The MMT's unique operation enables extremely compact, high-performance circuits that are particularly well suited to devices where size, energy use and image quality are critical – such as smartphones, tablets, smartwatches, automotive displays, and future wearable devices.

The technology is already showing promise in simulations, with real-world applications in AMOLED and microLED displays – two of the most advanced and rapidly growing areas of screen technology. It can also be integrated into current production lines with minimal disruption.

Dr Eva Bestelink, Senior Research Fellow at the University of Surrey's Advanced Technology Institute, said:

"I've been working on this technology since my undergraduate days at Surrey, where I had the idea to develop a transistor based on neural behaviour, so seeing it evolve into something with real-world potential is incredibly rewarding. We've shown that it's possible to rethink how displays are built without starting from scratch.

"The MMT lets us design circuits that perform better while also being cleaner and cheaper to make. That's a win for manufacturers, a win for users and a win for the environment. Beyond displays, it could also have major applications in areas like microfluidics, imaging arrays and hardware AI. We're still actively researching the AI potential, but the implication for revolutionising manufacturing is clear – especially if we're to achieve Net Zero."

Dr Bestelink and Dr Sporea will present their research on 15 and 16 May at this year's Display Week 2025 Technical Symposium in San Jose, California. Their invention – the multimodal transistor (MMT), now granted a US patent – builds on more than two decades of pioneering research in thin-film electronics at the University of Surrey.

Image: By Redd Angelo in Technology CC0 license

Surrey Uni Research Exposes Toll of Controlling Coaching on Athletes' Health

Controlling coaching tactics shatter athletes' wellbeing, says new study

Controlling coaching styles disrupt athletes leaving them vulnerable to physical and psychological strain, according to a new study from the University of Surrey and the Université du Québec à Montréal, Canada.

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This exposes a critical flaw in current sporting culture that prioritises results over athlete welfare. The research argues that coaches who micromanage and belittle athletes are fuelling both acute stress and burnout in their teams.

The study, published in Motivation and Emotion, tracked 72 student-athletes from Université du Québec à Montréal, Canada, using daily diaries to capture their experiences and heart rate variability (HRV) measurements to assess their stress responses. This combination of psychological and physiological data provides a comprehensive picture of how coaching behaviours seep into athletes' daily experiences, affecting their motivation and mental state. Researchers analysed how athletes perceived their coaches' behaviour and then linked these perceptions to both their psychological needs (satisfaction or frustration) and their psychobiological health.

Autonomy-supportive coaches – those encouraging choice and collaboration – boosted athletes' mental resilience. In contrast, controlling tactics like public criticism and arbitrary punishments spiked acute stress and eroded long-term wellbeing.

Dr Sebastiano Massaro, Associate Professor of Organizational Neuroscience and co-author of the study at the University of Surrey said:

"It's heart-breaking to see how these controlling tactics, often masked as 'discipline' or 'tough love', are fundamentally damaging our athletes."

Florence Jauvine, at the Université du Québec à Montréal, Canada, added:

"We're not just talking about hurt feelings; we're seeing measurable increases in stress and burnout that can have long-term consequences for their careers and their lives."

The research highlights a crucial counterpoint: when coaches support athletes' autonomy – giving them choices, acknowledging their perspectives, and encouraging their growth – it fuels their psychological needs, leading to greater engagement and acting as a buffer against burnout. The data shows a powerful connection between autonomy-supportive coaching, need satisfaction, and positive athlete outcomes.

Dr Sebastiano Massaro continued:

"We urge sporting organisations and governing bodies to implement urgent changes. This includes mandatory training for coaches at all levels, focusing on autonomy support and the detrimental effects of controlling behaviours. A shift in emphasis is required, moving away from a win-at-all-costs mentality towards a model that prioritises the holistic well-being of athletes."

Supporting Bees and Pollinators in Your Epsom and Ewell Garden

Expert Advice on Supporting Bees and Pollinators in Your Epsom and Ewell Garden

Epsom and Ewell residents are being offered expert advice on how to make their gardens more welcoming for bees and other vital pollinators, thanks to insights from local academics.

Will Wilkinson and Dr Jorge Gutierrez Merino, both from the University of Surrey, have shared practical tips for nurturing these important species. Mr Wilkinson is a lecturer and leads The Beekeeping Project at the university, while Dr Gutierrez Merino is a senior lecturer.

Their advice highlights that while honeybees are important, it's crucial to support the many other pollinator species that are often more vulnerable.

Key recommendations for local gardeners include:

- **Recognise the bigger picture:** While honeybees are "kept species," conservation efforts should also focus on other less conspicuous pollinators vital to our food web, many of which are more at risk.
- **Plant native and heritage varieties:** Opt for native plant species and traditional heritage varieties in your garden. Not all modern plants produce the quantity of pollen and nectar that pollinators require.
- **Ensure year-round food sources:** Aim for a diverse range of plants that flower across different seasons, including

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trees, to provide a continuous supply of food for pollinators.

- **Create a "rough patch":** Leaving a corner of your garden unkempt, perhaps with a pile of old sticks, allows it to overgrow. This helps retain moisture and creates a humid microclimate beneficial for various invertebrates.
- **Consider #NoMowMay:** Avoid mowing your lawn throughout May. This allows native plants to flower and provides a crucial habitat for insects to thrive.
- **Review pet treatments:** If your pet regularly receives flea or worm treatments, discuss a risk-based approach with your vet instead of monthly preventative applications. Residues from some spot-on treatments have been detected in UK habitats and can negatively affect invertebrate survival.

The Beekeeping Project at the University of Surrey

The advice stems from work connected to The Beekeeping Project at the University of Surrey. Led by Will Wilkinson and funded by the Student-Staff Partnership Project and Forever Surrey, the initiative provides students, staff, and the wider university community with opportunities to learn about beekeeping, the environment, and develop new skills. It also aims to support student experience and mental health.

The project has fostered interdisciplinary research, including studies into the beehive microbiome as an indicator of honeybee health, led by PhD student Kerry Barnard and Dr Jorge Gutierrez-Merino. This research investigates how bacterial communities within the hive correlate with the health and disease status of bees and other pollinators.

Through workshops, teaching materials, and practical experience, The Beekeeping Project has encouraged discussion and shared knowledge about bees, gardens, and nature, emphasising the importance of all bee species for biodiversity, ecology, and sustainability – principles central to the University of Surrey's ethos.

Residents interested in learning more can note that Will Wilkinson and Dr Jorge Gutierrez Merino are available for interview by contacting mediarelations@surrey.ac.uk.

Surrey in race to capture carbon

A unique carbon capture technology developed by researchers at the University of Surrey could offer a more cost-effective way to remove carbon dioxide (CO_2) from the air and turn it into clean, synthetic fuel.

A study published in Applied Energy demonstrated that the Dual-Function Material (DFM) process – which combines carbon capture and conversion – could match or outperform more established industry methods. Under optimal conditions, it was shown to remove carbon at a cost of US$740 per tonne, with the potential to drop below $400 as materials improve.

Dr Michael Short, Associate Professor of Process Systems Engineering at the University of Surrey and lead author of the study, said:

"For the first time, we've been able to demonstrate it can be financially competitive to use DFMs for direct air capture (DAC) – all the while creating clean fuel like methane in the process.

"Using green hydrogen from renewable electricity and carbon from the atmosphere, our system can help to replace fossil feedstocks in sectors like steel manufacturing. If a steel mill uses this fuel, it could effectively have zero net emissions – offering a sustainable path to decarbonise industries that are otherwise hard to electrify."

Using superstructure optimisation – an advanced modelling technique – the team tested a wide range of configurations to identify the most cost-effective design for capturing 10,000 tonnes of CO_2 per year – a scale comparable to other commercial systems.

With further improvements in material performance and catalyst cost, researchers suggest it could hold promise for large-scale deployment and can be integrated with existing industry infrastructure.

Dr Melis Duyar, Associate Professor in Chemical and Process Engineering at the University of Surrey, said:

"Recycling carbon in this way is a powerful idea, with potential to create many new value chains and enable energy independence by embedding renewable energy into the production of conventional fuels and chemicals."

The Intergovernmental Panel on Climate Change (IPCC) warns that limiting global warming to 1.5°C will require not only cutting

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emissions but also removing billions of tonnes of CO_2 from the atmosphere this century.

In the lead up to Net Zero target deadlines, the technology offers a promising and economically viable route to help achieve that goal – while helping us to reduce overreliance on fossil fuels.

Surrey Uni leads microbe recyling of lithium batteries

A microbial electrochemical technology capable of recovering 90-95% of lithium from spent lithium-ion batteries has been developed by scientists at the University of Surrey.

The breakthrough offers a more sustainable and cost-effective alternative to conventional recovery methods and could be expanded to reclaim other valuable battery metals, like cobalt.

Funded by the Biotechnology and Biological Sciences Research Council (BBSRC), the BioElectrochemical LIthium rEcoVEry (BELIEVE) project set out to tackle one of the biggest challenges in lithium-ion battery recycling – reducing the environmental and economic costs.

Professor Claudio Avignone Rossa, Professor of Systems Microbiology at the University of Surrey and principal investigator on the project, said:

“Lithium-ion batteries power so much of our modern technology, from phones to electric vehicles, but current recycling processes remain energy-intensive, costly and inefficient. Our goal was to develop a bioelectrochemical system (BES) that uses microbial electrochemical technology to extract high-purity lithium from used batteries – which is currently very difficult to do.”

Traditional methods recover small amounts of lithium, sometimes as little as 5%, while more advanced techniques achieve higher yields but rely on corrosive chemicals.

Professor Jhuma Sadhukhan, Professor of Engineering and Sustainability at the University of Surrey and co-lead on the project said:

“This project is timely due to stringent legislation for material security, particularly tech-metals like lithium. With this respect, extraction-precipitation, electrosynthesis and crystallisation have been tried to recover lithium from brines; however, the methods have posed specific challenges, including low recovery of lithium compounds.

“Biotechnology-based biorefining is needed to close the LIB loop and thereby improve product grades and recovery rates, process robustness, social justice, economic returns, health, safety, environment and legislation. In this research, we optimised a biological system to recover high purity lithium from industrial black mass, a used lithium-ion battery material after thermal and mechanical processing, separating aluminium and iron.”

Dr Siddharth Gadkari, Lecturer in Chemical Engineering at the University of Surrey and co-lead on the project, said:

“By harnessing specially selected microorganisms to transfer electrons and extract lithium, we have developed a cleaner, more sustainable approach that dramatically reduces reliance on harmful chemicals.

“Our next steps will focus on proposals to expand the technology to recover and separate all valuable metals from batteries, including high-value cobalt, nickel and manganese. While challenging, this is a crucial step toward establishing a truly circular battery economy.”

Developing a scalable process that efficiently recovers lithium, cobalt and other valuable metals will not only reduce waste but also lessen dependence on environmentally damaging mining practices.

It also closely aligns with EU Green Deal 2020 regulations, which aim for a 65% recycling efficiency for lithium-ion batteries and a 70% material recovery rate for lithium by 2030. Similar regulations are anticipated in the UK, underscoring the significance of the BELIEVE project’s contributions to sustainable technology and resource management.

The team now plans to put forward new proposes to explore how they can recover all metals from lithium-ion batteries.

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Surrey Uni Study: long Covid patients proving their illness is real challenges

People living with Long Covid often feel dismissed, disbelieved and unsupported by their healthcare providers, according to a new study from the University of Surrey.

The study, which was published in the Journal of Health Psychology, looked at how patients with Long Covid experience their illness. The study found that many patients feel they have to prove their illness is physical to be taken seriously and, as a result, often reject psychological support, fearing it implies their symptoms are "all in the mind".

Professor Jane Ogden, co-author of the study from the University of Surrey, said:

"We found that the problem isn't people with Long Covid refusing help – it's about the deep need for people to be believed. When a patient feels dismissed, offering psychological support instead of medical care can be misconstrued as insulting."

According to the Office for National Statistics, there are 1.9 million people who live with Long Covid in the UK. Long Covid symptoms include fatigue, difficulty concentrating, muscle aches and shortness of breath, which persist for many weeks, sometimes months, after the initial Covid-19 infection.

Surrey's study involved in-depth interviews with 14 people in the UK between the ages of 27 to 63 who had experienced Long Covid symptoms for more than four weeks. The group included 12 women and 2 men.

Saara Petker, clinical psychologist, co-author of the study and former PhD student at the University of Surrey, said:

"We found that our participants are living a life of constant uncertainty, struggling to find treatment. People told us that they didn't feel listened to, some said they'd lost trust in doctors, their social circles and even their own bodies because of the whole experience.

"Medical advice is crucial – but psychological support must be offered with care. If it's seen as replacing medical help, it can feel dismissive."

Image: License details Creator: Jose Luis Navarro. Copyright: CC BY-SA 4.0

Surrey leads lateral thinking about vertical farming

Can vertical farming be the key to improving and safeguarding the United Kingdom's food system? This is the central question behind a new research project led by the University that has been awarded £1.4 million by UK Research and Innovation (UKRI).

The Vertical Farming to Improve UK Food System Resilience (VF-UKFSR) project will investigate how vertical farming can improve the country's supply of nutritious leafy greens, essential for a healthy diet.

Vertical farming is a method of growing crops in stacked layers, often indoors, using controlled environments. Unlike traditional farming, it doesn't rely on soil or natural sunlight. It uses soilless techniques and artificial lighting to create optimal conditions for plant growth. This allows crops to be grown year-round, regardless of weather conditions and makes more efficient use of space and resources.

Dr Zoe M Harris, project lead from the University of Surrey's Centre for Environment and Sustainability, said:

"Our project is keen to explore how vertical farming can provide local, diverse, and culturally appropriate food, given its potential to grow a wide variety of crops. So far, there's been little in-depth analysis of the risks to our country's leafy greens supply nor a thorough examination of the benefits and trade-offs vertical farming could bring to the UK's food system. Thanks to this grant from UKRI, we're excited to change that and create a clear roadmap to unlock this potential on a larger scale."

The research team will work closely with farmers, industry, government and the community to make sure that the outputs of the project focus on real-life and immediate benefits.

The core team is made up of whole-system, environmental and social scientists, UK Urban AgriTech (UKUAT) and five farm partners – Flex Farming, Innovation Agritech Group, Farm Urban, GrowPura, and LettUs Grow.

Dr Lada Timotijevic from the University of Surrey said:

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“Our research is all about identifying and understanding the risks to our food system and seeing how vertical farming can help tackle these challenges. We want to create tools that make it easy to see the impact of expanding vertical farming on considerations including food supply, land use, and the environment, so we can make smart decisions for the future.

“We’re also focused on understanding the public’s perceptions of vertical farming and the social conditions needed for vertical farming to succeed, as well as on working closely with farmers, industry, and policymakers to build a roadmap that supports its growth across the UK.”

The project’s leadership team consists of:

- University of Surrey: Dr Zoe M Harris, Dr Lada Timotijevic, Dr Lirong Liu, Dr James Suckling, Dr Damiete Emmanuel-Yusuf
- University of Aberdeen: Professor Astley Hastings
- University of Sussex: Dr Alexandra Penn
- UKUAT: Mark Horler

Image: Vertical farm. Credit ifarm.fi Creative Commons Attribution-Share Alike 4.0 International