March 2018

# Advanced Technology Institute Newsletter
# Faculty of Engineering and Physical Sciences

## News

### UNIVERSITY OF SURREY TO OPEN NEW £4MILLION NANO-MANUFACTURING HUB TO KICK-START UK'S SMART DEVICE REVOLUTION

The Engineering and Physical Sciences Research Council (EPSRC) has awarded £1.6m to the Advanced Technology Institute (ATI) and the 5G Innovation Centre (5GIC) at the University of Surrey to establish a hub that will make the manufacturing of smart materials and self-powered electronics a reality in the UK.
The £4.2m project, supported by 32 partner organisations, was co-developed with QinetiQ and the National Physical Laboratory (NPL).

The University of Surrey will use some of the funds to purchase the innovative NanoOPS printer, designed by Northeastern University that will give the hub the ability to produce plastic nanoscale electronics suitable for devices such as wearable sensors, electronic tags, and various wireless technologies. The NanoOPS printer removes the bottleneck in high-throughput and reliable nano-fabrication manufacturing. The hub will be able to reduce, by a factor of ten, the cost of manufacturing plastic electronics, supporting the development of internet-of-things (IoT) devices for smart-homes, smart-cities, and smart factories.

**Professor Ravi Silva**, Director of the ATI and the new nano-manufacturing Hub, said: "This is an exciting project for the University of Surrey and our partners. We will develop new technologies and techniques that will allow us to make the dream of a fully wireless smart home or smart factory commonplace in the UK."

Professor Max Lu, President and Vice-Chancellor of the University of Surrey, said: "One of our main goals at the University of Surrey is to produce research that can make a positive contribution to society and impact industries across the globe. I am confident that this collaboration between our world-class facilities – the 5G Innovation Centre and Advance Technology Institute – and private businesses will be a tremendous success and pave the way for future innovation in nano-technology."

The new facilities are expected to be operational in third-quarter of 2018.

**IN THIS ISSUE**

# NEW JOURNAL HERALDS A FUTURE ERA OF 'FREE ENERGY'

**Professor Ravi Silva** has been appointed as joint Editor-in-Chief of 'Energy and Environmental Materials', a leading edge journal which will be a platform for the most significant and impactful research in the field of materials for energy.

Professor Silva is a pioneer of world-leading research in the field of nanomaterials and renewable energy. He joined academics from universities around the world for the journal's launch and first Editorial Forum held in Zhengzhou, China, on 11 November 2017.

The journal has been launched by Wiley in response to the increasing focus on energy and environmental materials as the key driver for viable renewable energy. There is a significant reliance on new materials and processes to deliver a cleaner and sustainable environment for future society.


Professor Silva explained: "Within one hour, the sun provides the earth with enough energy to power the world for a year. The key challenge we have is developing materials that can first capture that energy effectively, and then store it for use when the sun does not shine. If we can overcome these material challenges, within the next 20 to 30 years we could see free power for all via renewable energy systems – much like air and water. At Surrey, within the ATI we have a number of research programmes in printable and flexible solar cells for energy harvesting outdoors and indoors. We will augment this work with a proposed new UK-China Battery Network that will look to novel materials systems for efficient and high capacity energy storage".
Energy and Environmental Materials will publish a combination of standard articles, high quality reviews focusing on societal impact, and very significant breakthrough papers.

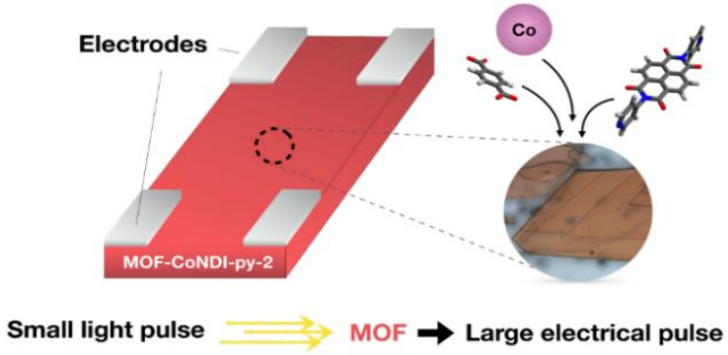
"I am delighted to have been appointed as Editor-in-Chief of this prestigious new journal," said Professor Silva. "I look forward to a really exciting time, bringing together some of the most influential scientists talking about areas that are going to impact all of us in the near future."

Professor Max Lu, President and Vice-Chancellor of the University, said: "My warm congratulations to Ravi on his appointment as Editor-in-Chief of Energy and Environmental Materials. It is a very significant journal by Wiley in an important field of research. Ravi has a stellar track record in related areas, and his leading role in this journal is further international recognition of his achievements"

## RECORD HIGH PHOTOCONDUCTIVITY FOR NEW METAL-ORGANIC FRAMEWORK MATERIAL

An international team of scientists, from the University of Surrey, University of São Paulo (Brazil), the University of Warwick and the University of Grenoble-Alpes (France), has created a new metal-organic framework (MOF) that has shown record high photo-conductivity levels for a material of its type.
The team published its findings in the Nature Communications journal where it reported that its MOF had a responsivity rate of 2.5 x $10^5$ A/W. The team's MOF was made by using cobalt (II) ions and naphthalene diimides and acid ligands.

MOFs are compound materials that are made of ions and ligands to make 3 dimensional structures. MOFs are typically used to store gas and to separate and purify chemicals, but the scientists hope that their new discovery could lead to MOFs being used to make photoactive materials such as solar cells.




**Professor Ravi Silva**, Director of the Advance Technology Institute, said:
"Metal Organic Frameworks have been gaining a tremendous amount of interest of late for their potential to be used for gas storage, sensing and catalysis – but it is clear that they could be used for so much more.
"This is a great example of how collaborating on an international scale can result in truly exciting discoveries that have the potential to change the direction of a number of industries."

## WHY THE SKY'S THE LIMIT FOR SOLAR ENERGY

In an interview with nanotechweb.org, **Professor Ravi Silva** outlines how research into processed organic materials could enable solar energy systems that cost a thousandth of their current price.

Professor Silva, Head of Surrey's Advanced Technology Institute (ATI), gave the in-depth interview with leading nanotechnology website nanotechweb.org during the 2nd International Conference on Advanced Energy Materials, which took place at the University of Surrey on 11 to 13 September 2017.

The Earth receives enough energy in an hour to power civilization for a year. However, capitalising on the opportunities offered by solar power requires solar cells that are highly efficient, but cheap to make and install. While first generation silicon-based solar photovoltaic (PV) systems offer one answer, the costs of processing and installing these cells is still too high for them to replace fossil fuels, and subsequent solutions for solar cells have not been able to match the performance or the reliability of first generation systems.

Professor Silva hopes that a fourth generation of solar cells, being developed in the ATI, will achieve the balance of efficiency and cost needed to bring about a solar-power revolution. Using learnings from the previous technologies, he and his colleagues aim to develop composite cells that combine the efficiency benefits of inorganic materials and nanostructures, with the convenience and low cost of 'solution-processable' organic polymers.

## BEST PAPER AWARD AT THE 40TH INTERNATIONAL SEMICONDUCTOR CONFERENCE

**Dr Radu Sporea** and **Prof Ravi Silva** won the Best Paper Award at the CAS 2017 conference, held between 11 and 14 October in Sinaia, Romania.


The paper, entitled "Design Considerations for the Source Region of Shottky-Barrier Source-Gated Transistors" presents findings on the optimization of electronic devices with applications in wearables, remote sensors and printed electronics.

Dr Radu Sporea said: "It is a great honour to receive this award, and indeed to participate to the 40th edition of the CAS conference. The event is an excellent venue for sharing ideas and forging new research partnerships, and I am very pleased with the interest that our work has generated".

## ATI WINS ERC ADVANCED INVESTIGATOR AWARD

Congratulations to **Professor Markus Pollnau** on his new ERC Advanced Grant. This grant has three aims: the fundamental theoretical and experimental understanding of the laser linewidth; the development and investigation of ultranarrow-linewidth lasers in rare-earth and transition-metal doped dielectric aluminum oxide layers on silicon wafers; and the exploitation of these lasers for intra-laser-cavity optical sensing on a micro-chip.

The grant will exploit the ultra-narrow linewidths and ultra-high internal photon densities achievable in these dual-wavelength, distributed-feedback, dielectric waveguide lasers to perform on-chip-integrated, intra-laser-cavity optical sensing with unprecedented sensitivity. Simple electrical read-out of the change in laser frequency and linewidth induced by the measurand is realized by photo-detection of the GHz beat-frequency signal produced between the perturbed and reference resonance of the dual-wavelength laser.

## PhD News

**Welcome -** The ATI welcomes: Pavlos Giannakou, Holly-May Lewis, Bowei Li, Barbara Salonikidou and Jessica Smith to the PhD cohort that joined us in October 2017 and Elena Lupo, Michal Delkowski and Victoria Ferguson to the PhD cohort in January 2018. We wish them well in their research.

## Other News

Congratulations to Dimitar Kutsarov and Jessica on the arrival of Audra Sonya Kutsarov-Walsh.