

JOINT NEWS RELEASE

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NTU Singapore and Panasonic develop multi-material printer to 3D print flexible smart devices quickly

Scientists from **Nanyang Technological University, Singapore (NTU Singapore)**, **Panasonic Factory Solutions Asia Pacific Pte. Ltd. (Panasonic)**, and **Singapore Centre for 3D Printing (SC3DP)** have developed a new multi-material printer using multi-wavelength high-power lasers, for quick and easy 3D printing of smart, flexible devices.

The multi-material printer works by utilising varying wavelengths of laser, creating thermal and chemical reactions capable of transforming common carbon-based materials (polyimide and graphene oxide) into a new type of highly porous graphene. The resulting structure printed with this new graphene is not only light and conductive, but it can also be printed or coated onto flexible substrates like plastics, glass, gold and fabrics, creating flexible devices.

Electronic devices and components have traditionally been comprised of rigid materials such as metals, silicon, and ceramics, but there has been an increasing interest in the creation of flexible wearable electronics that can be bent, twisted, and easily conformed to various surfaces.

Co-leader of the project, **Associate Professor Murukeshan Vadakke Matham** from **NTU School of Mechanical and Aerospace Engineering (MAE)** and **SC3DP**, the national centre of excellence in 3D printing housed at NTU, said: "Our project aims to find a way to 3D print new materials like organic polymers and carbon-based materials like graphene, which has properties that allow them to be printed or coated onto flexible substrates like plastics or fabrics, creating flexible and stretchable circuits."

Assoc Prof Murukeshan, who is also Principal Investigator at Singapore's **National Additive Manufacturing Innovation Cluster (NAMIC)** added, "3D printed flexible electronics paves the way for more comfortable and mobile wearable devices as it can be lighter and smaller. We can now create unique structures that were previously impossible with traditional rigid electronics."

3D printed sensor for smart intravenous fluid bag

The newly created 3D printer has already attracted interest from various companies, including from American multinational manufacturer **JABIL-MTI Penang**.

JABIL-MTI Penang aims to integrate 3D-printed graphene-based electronics into a smart infusion system. A proof of concept has been demonstrated through a prototype of a low-cost intravenous (IV) fluid bag with an embedded printed sensor powered by artificial intelligence. The device monitors the status of the IV drip, regulates parameters such as pressure flow and temperature, and transmits the information to a smartphone in real-time. This allows medical personnel to remotely monitor, control and detect abnormally efficiently.

The research team also tested the possibility of integrating 3D printed components into the fabrication of high-performing electronics like pressure sensors and heaters, with funding support from NAMIC.

Mr Lim Lai Ming, Project Manager, Jabil-MTI Penang, said, “We greatly value NTU and Panasonic teams’ creative thinking and innovative approach, and we are excited about the possibilities for future collaborations. We eagerly look forward to exploring further opportunities to work together and leverage both their teams’ exceptional innovation expertise.”

Co-leader of the project, **Dr Low Mun Ji, General Manager of Panasonic**, said: “Our technology allows the creation of highly porous and conductive graphene-based material for use in different applications. Compared to traditional graphene manufacturing methods, our method is faster, cheaper, and highly compatible with a wide range of materials.”

The NTU-Panasonic team believes that the newly created 3D printer offers a level of flexibility and functionality unmatched by other similar products in the market. The project members said the innovation has the potential to revolutionise the field of 3D printing and open new possibilities for new product design and innovation.

The project between NTU and Panasonic to develop the new multi-material printer was launched in 2016 with the support of the Singapore Economic Development Board (EDB) under the Industrial Post-graduate Programme (IPP). Over the years, the project team has filed two patents, presented at 11 international conferences, and published 11 papers. It has also supported three Panasonic scientists and engineers who completed a doctorate degree from NTU.

Professor Paulo Bartolo, Executive Director, SC3DP, said, “At the Singapore Centre for 3D Printing (SC3DP) we are investigating the use of additive manufacturing

for many applications and industrials sectors, including electronics and wearable devices. Panasonic is a strategic partner, and I am very pleased with the excellent results achieved through this project. This was possible thanks to the hard work of the team of researchers from both SC3DP and Panasonic. The project is a good example of the technical and scientific capabilities available at our centre, and how we can support the industry and create value.”

As next steps, Panasonic has set up a new facility for laser-based manufacturing systems at its research hub in Singapore, to enable further trials of concepts using components fabricated by the multi-material printer, as part of “Autonomous Factory” – a Panasonic concept for smart factories of the future. The new facility is to be led by Dr Low and researchers Dr Nicholas Tham and Dr Joel Lim, who were also involved in the joint NTU-Panasonic project.

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Notes to Editor:

Other members of the research team from the NTU School of MAE who were involved in the project since its launch in 2016 include former Nanyang Assistant Professor Kim Young Jin, former research associates Mr Daryl Lim and Mr Rohith Thazhe Madam, as well as former research fellows Dr Suchand Sandeep, Dr Hyub Lee, Dr Pankaj K Sahoo and Dr Hu Liang Xiang.



Image: Prototype of the JABIL-MTI Penang smart infusion system, which includes a low-cost intravenous (IV) fluid bag with an embedded printed sensor powered by

artificial intelligence. The innovation is a joint development among Panasonic, NTU, NAMIC and JABIL-MTI. Credit: JABIL-MTI Penang

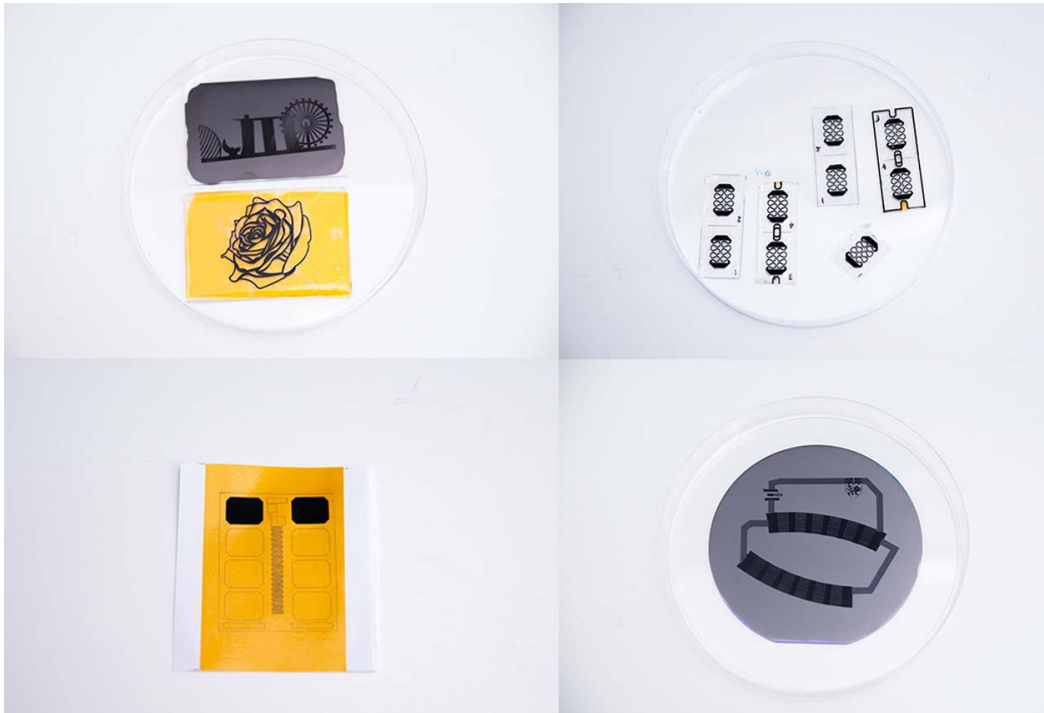


Image: (Top row, L-R) 3D printed graphene structures on glass and flexible rubber substrates. (Bottom row, L-R) The newly created pre-design graphene layer on a paper and silicon base. Credit: NTU Singapore

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About Nanyang Technological University, Singapore

A research-intensive public university, Nanyang Technological University, Singapore (NTU Singapore) has 33,000 undergraduate and postgraduate students in the Engineering, Business, Science, Medicine, Humanities, Arts, & Social Sciences, and Graduate colleges.

NTU is also home to world-renowned autonomous institutes – the National Institute of Education, S Rajaratnam School of International Studies, Earth Observatory of Singapore, and Singapore Centre for Environmental Life Sciences Engineering – and various leading research centres such as the Nanyang Environment & Water Research Institute (NEWRI) and Energy Research Institute @ NTU (ERI@N).

Under the NTU Smart Campus vision, the University harnesses the power of digital technology and tech-enabled solutions to support better learning and living experiences, the discovery of new knowledge, and the sustainability of resources.

Ranked amongst the world's top universities, the University's main campus is also frequently listed among the world's most beautiful. Known for its sustainability, over 97% of its building projects are certified Green Mark Platinum. Apart from its main campus, NTU also has a medical campus in Novena, Singapore's healthcare district.

For more information, visit www.ntu.edu.sg

About Panasonic

Panasonic Factory Solutions Asia Pacific Pte. Ltd. is a part of the global manufacturing, service and sales bases companies of innovative high-end factory automation equipment and services of customers worldwide under the Panasonic Automation Business Division of Panasonic Connect. Panasonic Connect, a B2B company, involves supply chain, public services, infrastructure and entertainment with approximate 28,500 employees, generating annual sales at approximately JPY924.9 billion (FY2022).

Panasonic Factory Solutions Asia Pacific Pte. Ltd. is a total solutions provider, delivering advanced manufacturing and innovative solutions that strongly add value to our customer's production and process, thereby enhancing their throughput and production. Since 1989, Panasonic has been manufacturing Auto Insertion (AI) machines in-house and added Surface Mount Technology (SMT) machines, Laser Marking machines and Odd Form Insertion machines to their product range over the years. For more information about Panasonic Factory Solutions Asia Pacific Pte. Ltd., please visit <https://pfsap.sg.panasonic.com> .