



**DATA COM**



**WEARABLES  
AND HEALTH**



**ENERGY**



**SENSORS  
AND IOT**



**LARGE SCALE  
FABRICATION**

**GRAPHENE FLAGSHIP  
TECHNOLOGIES**

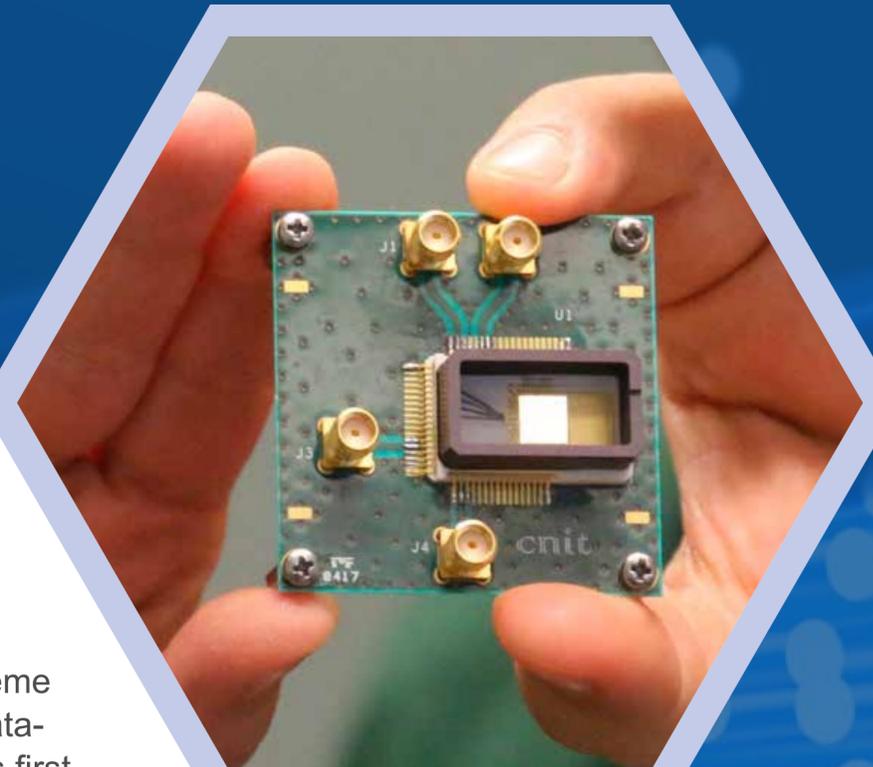




# DATAKOM

## NEXT GENERATION DATAKOM

Ultrafast data streams with extreme bandwidth are essential for a data-driven future. Discover the world's first all-graphene optical communication link operating at a data rate of 25 Gb/s per channel developed by AMO GmbH, CNIT and Imec.



## ULTRAFAST DATA

Ericsson will show a first prototype of a functional graphene-based optical ultrafast interconnection switch designed to be applicable in datacomms and 5G networks, with power efficient optical switching performance by natively overcoming the need of thermal control. At the Ericsson stand in Hall 2 (open to Ericsson customers and by invite only), Ericsson and CNIT will present switching of a 100Gb/s channel in an Ericsson testbed.

 consorzio nazionale  
interuniversitario  
per le telecomunicazioni

 AMO

**NOKIA**

  
**ERICSSON**

  
**imec**  
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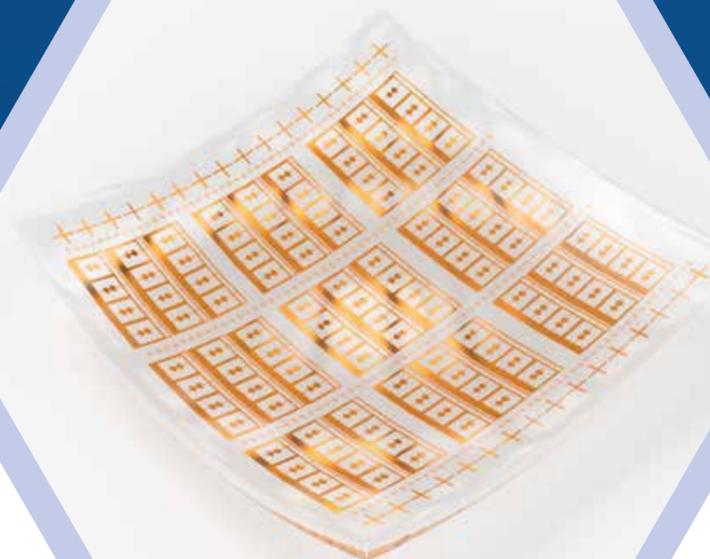




## DATA COM

### FLEXIBLE CIRCUITS FOR A FLEXIBLE FUTURE

Low-cost, flexible circuits, like those developed by RWTH Aachen University and AMO GmbH, will be the building blocks of fully flexible devices such as smartphones. Flexible graphene enables a range of circuits needed for key functionality in fully flexible electronic devices. Flexible electronics and smart textiles will be key to taking the Internet of Things everywhere.



### FLEXIBLE SENSORS FOR NEW NETWORKS

The first flexible THz sensor developed by Chalmers University of Technology brings high frequency electronics to flexible devices. Graphene combines flexibility and high frequency response for new powerful electronics systems. Terahertz sensors open up new possibilities in high frequency communications, wireless sensor networks, imaging, wearable devices and smart clothing.

### FLEXIBLE WIRELESS CONNECTION

With this fully flexible graphene microwave communication devices created by AMO GmbH and RWTH Aachen University, no rigid parts are needed to connect flexible devices to the internet. Graphene's flexibility and excellent electronic properties make truly bendable electronics possible. This microwave link can be integrated into flexible phones and fully flexible wearables and health devices for comfortable smart tech.



**CHALMERS**  
UNIVERSITY OF TECHNOLOGY



# ENERGY

## GRAPHENE-BOOSTED BATTERIES

The Cambridge Graphene Centre works on graphene batteries that have improved energy storage and better performance over a lifetime of use and recharging. Adding graphene to the battery electrode improves energy capacity, lifetime and reliability. Our connected life is built on batteries. Graphene boosts performance to go further with mobile technology.

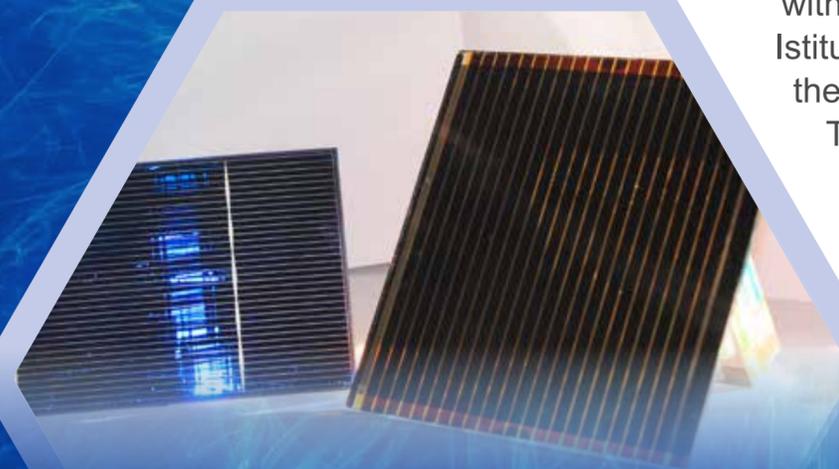


## ENERGY SUPER STORAGE FOR MOBILES

The graphene supercapacitors developed by Thales Research and Technology and the Istituto Italiano di Tecnologia store large amounts of energy and can charge and discharge rapidly. Graphene's excellent electrical properties allow super-fast energy transport and storing up to 100 times more energy. Graphene supercapacitors will enable super-fast charging of mobile devices and make high power more portable.

## GRAPHENE SOLAR POWER FOR SUSTAINABLE ENERGY

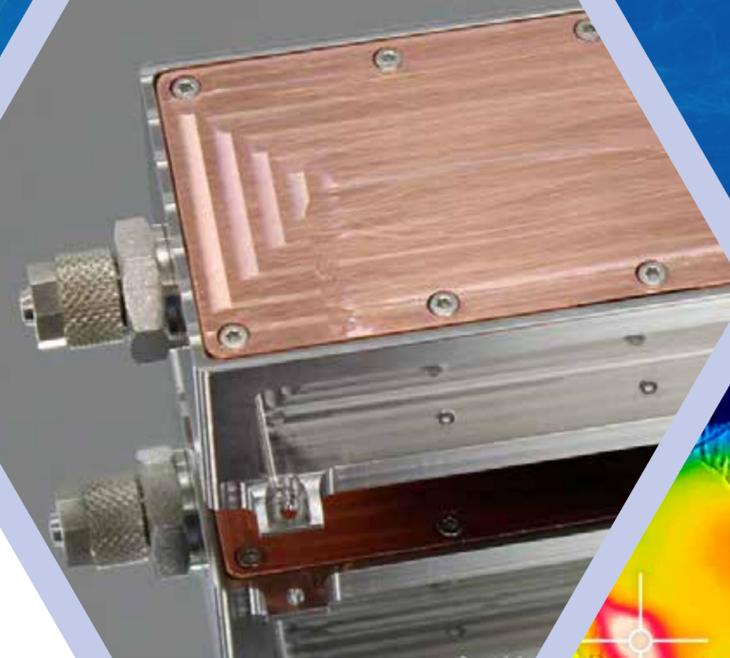
Large area perovskite solar cells with high power efficiency and long lifetimes are possible thanks interface engineering with graphene and related materials. The Istituto Italiano di Tecnologia together with the University of Rome Tor Vergata and TEI Crete use graphene's excellent electrical properties to evolve a solution to generate clean energy for a sustainable future.



# ENERGY

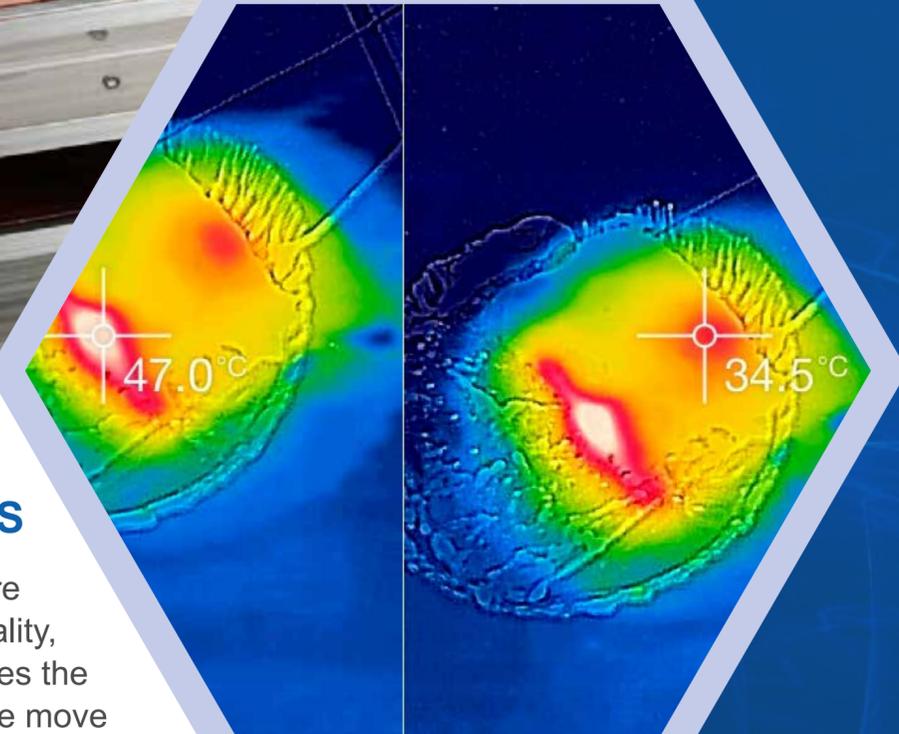
## DEEP FREEZE FOR CRYO-ELECTRONICS

Cool electronic systems down to ultralow, cryogenic temperatures with a miniaturised graphene-based cooling pump developed by APR Technologies, Chalmers University of Technology and SHT. The high efficiency of graphene and no moving parts means a more compact and reliable pump, ideal for mobile ultralow cooling in satellites and security, communications and healthcare.



## COOLING HIGH-POWER ELECTRONICS

Making electronic devices more compact with combined functionality, operating at faster speeds, increases the heat generated in these devices. The move towards the miniaturization and multi-functionality of electronics has increased demand for improved thermal management through the application of heat spreaders, thermal interface materials, and polymer composites such as the graphene thermal paste from the University of Manchester.



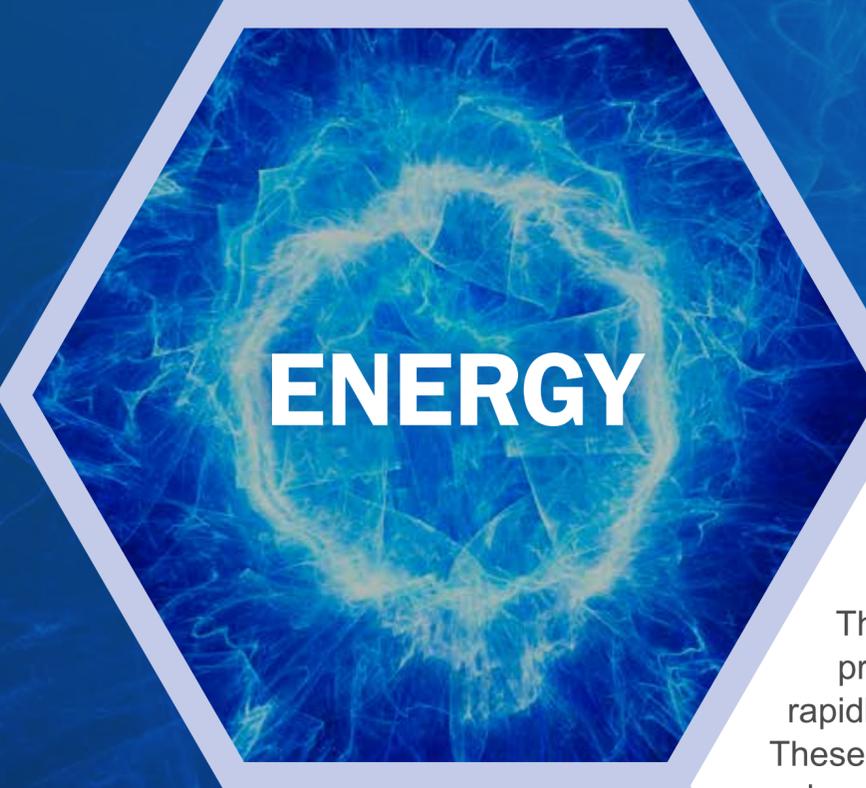
MANCHESTER  
1824  
The University of Manchester  
National Graphene Institute

APR  
Technologies

SHT

CHALMERS  
UNIVERSITY OF TECHNOLOGY





# ENERGY

## ADVANCED HEATING SOLUTIONS

The excellent thermal and electrical properties of graphene spread heat rapidly across graphene heating modules. These graphene heaters developed by CNR are chemically and thermally stable and prepared with a scalable and environmentally friendly process. Graphene-based heating modules can be easily integrated in many substrates suitable for aeronautical and automotive applications.



## SMART HEAT FOR SMART TEXTILES

Take heat anywhere with textiles coupled with thin plastic membranes embedded with a graphene network. This electrically activated membrane developed by BeDimensional rapidly delivers heat thanks to graphene's excellent thermal properties. Excellent for smart heating textiles and delivering localised heat for outdoor activities or medical situations.





## WEARABLES AND HEALTH

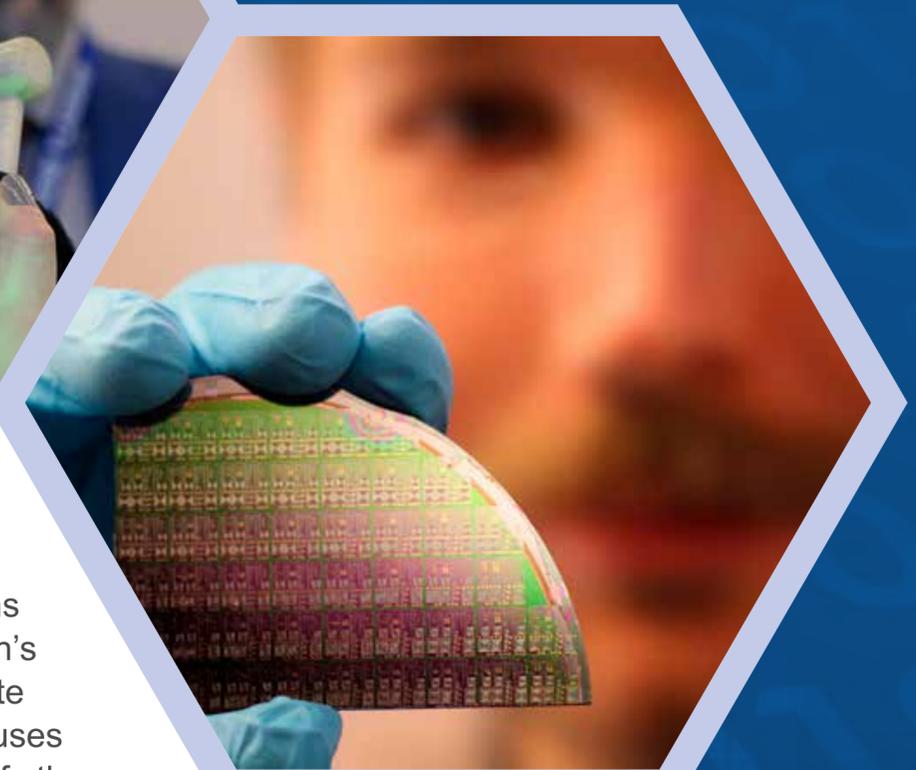
### CONTROLLING ROBOTIC LIMBS

The Istituto Italiano di Tecnologia have developed graphene nerve sensors that control motion and force in artificial robot limbs. The fast response of graphene ensures natural movement and gripping with non-invasive sensors and biocompatible. This allows comfortable and responsive prosthetic limb for people with motion impairments and demonstrates how graphene sensors could be used in biomedical devices.



### INFECTION MONITORING

A single drop of blood contains vital information about a person's health. The KTH Royal Institute of Technology infection monitor uses graphene photodetectors to identify the "molecular fingerprint" of diseases. In case of epidemic outbreaks, rapid infection monitoring for mobile point-of-care-diagnostics will reduce the critical delay between sample collection and test result.



 **ISTITUTO ITALIANO  
DI TECNOLOGIA  
GRAPHENE LABS**

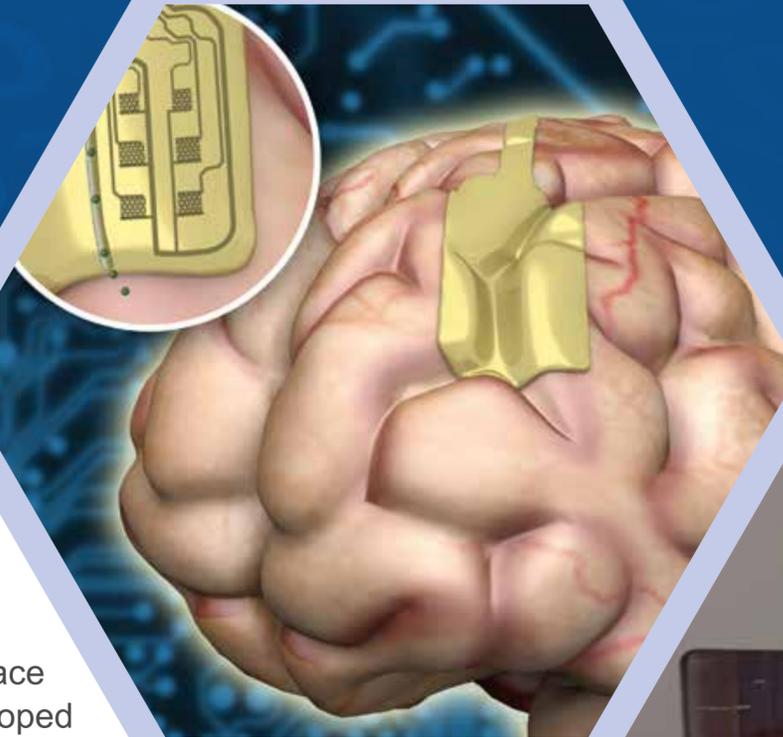
 **KTH Royal Institute  
of Technology**  
Stockholm, Sweden

# WEARABLES AND HEALTH



## NEURAL IMPLANTS FOR SPEECH THERAPIES

Flexible graphene brain implants can record and stimulate signals on the surface of the brain. The graphene implants developed by ICN2 and BrainCOM are more comfortable and less invasive, and more sensitive due to graphene's intrinsic electronic properties. High performance brain implants will improve understanding and treatment of neural diseases and progress towards brain-machine interfaces.



## CLEAN WATER FILTRATION

Graphene and graphene oxide membranes have the potential to create the ultimate clean water filter that can remove chemicals, solutes, salts and compounds such as pesticides from water. These membranes developed by the University of Manchester may be a viable future solution for desalination.



MANCHESTER  
1824  
The University of Manchester  
National Graphene Institute

ICN2  
Institut Català  
de Nanociència  
i Nanotecnologia

EXCELENCIA  
SEVERO  
OCHOA  
BRAINCOM





# WEARABLES AND HEALTH

## SMART PRESSURE-SENSING SHOES

Graphene in insoles can be used to track the pressure distribution across the foot for sports analysis and podiatry. The lightweight graphene-embedded insoles developed by the Cambridge Graphene Centre respond to variations in pressure for convenient tracking in all types of shoes. Smart shoes allow detailed performance monitoring for athletes and can provide feedback for people with foot conditions.

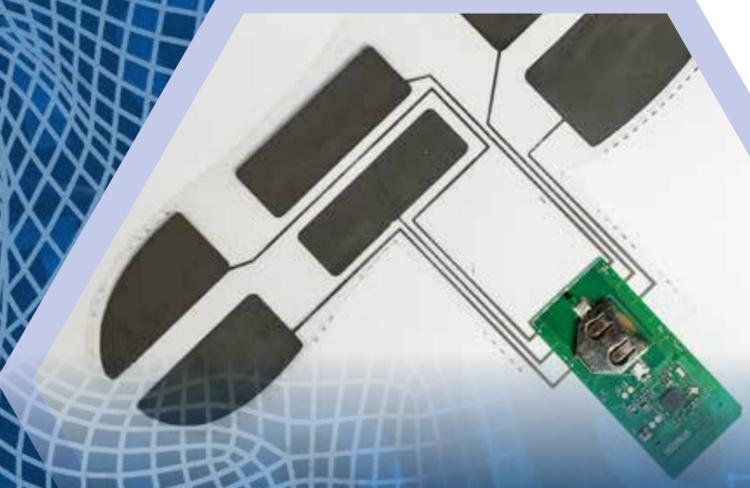


## HEALTH TRACKING STICKER

ICFO provides a wellness-monitoring platform in a wearable sticker for real-time health monitoring of heart rate, UV exposure and blood oxygen over skin. The flexible and transparent graphene makes the wellness sticker created by ICFO highly sensitive as well as comfortable and discreet to wear. Continuous monitoring of vital statistics will improve patient care and sports performance.

## FRESH AND COOL SHOES

The graphene soles in these shoes, created by the Istituto Italiano di Tecnologia in collaboration with BeDimensional and Fadel, keep feet cool, comfortable and fresh. Graphene keeps the feet cool with its excellent heat conductivity and enhances the sole's antimicrobial properties. The multifunctional benefits of graphene enhance footwear for more comfort in your daily life.

 UNIVERSITY OF CAMBRIDGE

BEDIMENSIONAL

ICFO

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FADEL  
Da sempre Tradizione e Innovazione



# SENSORS AND IOT

## SENSOR FOR VISIBLE AND INVISIBLE LIGHT

The wide-spectrum graphene light cameras developed by ICFO see details invisible to the human eye. They can detect light ultraviolet, visible and infrared light in the same image sensor. New technologies enabled by wide-spectrum imaging include quality screening for food safety, security, night vision and imaging systems for autonomous cars.

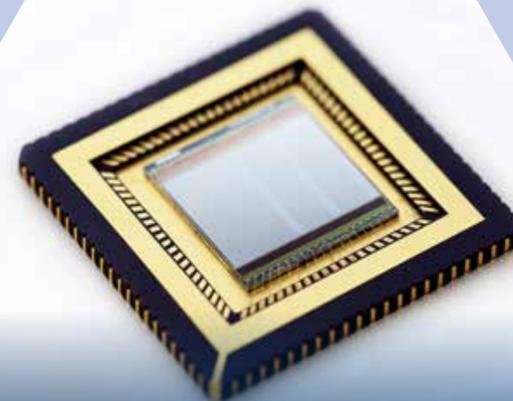


## WIDE-SPECTRUM INFRARED SENSORS

Emberion offers a packaged single pixel sensing solution with graphene-based photodetectors for visible light to short-wave infrared light. Thanks to graphene's excellent electronic properties this module has very low-noise detection with no need for cooling. These wide-spectrum sensors are ideal for sensitive spectrometry, gas detection and quality control.

## SMART PRINTED TEXTILES

GrapheneTech have developed graphene-based inks which give printed textiles added functionality of touch sensors and circuits. Low-cost graphene inks can replace metal inks for printed circuits for a wide range of smart devices. Graphene inks will lead to wide availability of flexible circuits and sensors for smart connections and the Internet of Things.



**EMBERION**



**ICFO**



# SENSORS AND IOT

## FLEXIBLE NFC DEVICES

CNR have developed NFC antennas made of conductive graphene derivatives which are suitable for flexible and curved surfaces and textiles. These graphene circuits provide a low cost, environmentally friendly alternative to metal antennas. Graphene expands possibilities for smart connections with NFC on flexible surfaces and smart textiles.



## FORCE-SENSOR DISPLAYS

Graphene-based touch sensors for screens developed by the Cambridge Graphene Centre enable the tracking of force as well as the location of touch points. Printed graphene sensors provide low-cost sensor circuits that can be easily integrated with smart screens. Force sensitivity adds another dimension to touch control of smartphones and devices for natural human-machine interaction.

## MULTIFUNCTIONAL PRINTED SENSORS

Cambridge Graphene Centre together with Novalia use a multifunctional printed graphene circuit with breath sensor, touch sensors and strain sensors to create a musical instrument. Printed graphene sensors can make everyday devices multifunctional. Simple, low-cost printed circuits will add functionality to a range of everyday items for smart interactivity.





## LARGE SCALE FABRICATION

### CREATING QUALITY GRAPHENE

Graphenea produces high-quality graphene for electronics. For its use in electronics, graphene is produced on wafers for CMOS integration. High quality graphene is a building block for new technologies exploiting graphene's excellent electronic properties. Graphenea's scalable production methods will support the next generation of technologies based on graphene.

 Graphenea