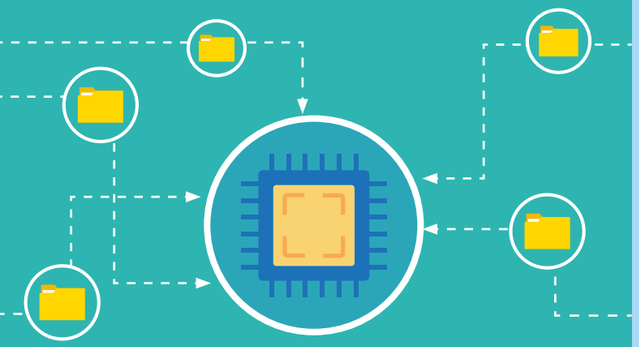
EVERLASTING DATA STORAGE

EPSRC-supported scientists have developed a thumbnail-sized hard drive which could conceivably store all the books ever written – and is likely to outlast our current information era, opening a new age of 'eternal' data archiving.

The device was created with five-dimensional optical storage technology using nanostructured glass and ultra-fast laser writing at speeds of one millionth of one billionth of a second. It was developed through fundamental research led by Professor Peter Kazansky at the Optoelectronics Research Centre at the University of Southampton, which EPSRC has supported for over 20 years.

The technology supports a data bank of human history incorporated into a Tesla Roadster electric car, currently on its way to Mars aboard a SpaceX Falcon Heavy spacecraft, which will subsequently journey forever around our solar system.

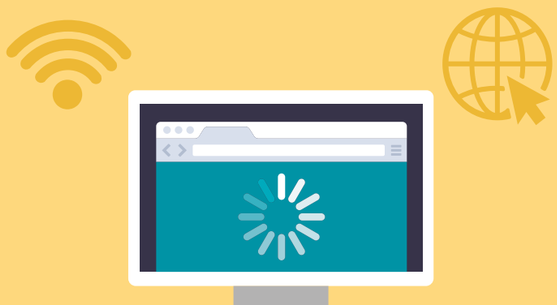


FASTER INTERNET ACCESS

Professor Alf Adams' ground-breaking 1980s research at the University of Surrey into infrared lasers paved the way for low-cost, low-power technology that has transformed the 21st century, from systems that cool the technology that drives the internet to barcode and Blu-ray disc technology.

Supported by EPSRC's predecessor, the Science and Engineering Research Council, Professor Adams' research was based on new ways to transform information into pulses of light, and led to 'strained quantum well laser' technology. It can provide much higher data capacity than conventional laser devices while using less electrical energy. The internet in particular relies on this feature, which makes it possible to send information around the planet much more quickly than has ever been possible.

At first, there were no takers for Professor Adams' technology – his idea was considered too radical – until the Dutch manufacturer Philips saw its potential. The rest is history that's still in the making.



A WORLD WITHOUT PHYSICAL SCIENCES WOULD MEAN A WORLD WITHOUT...

- EVERLASTING DATA STORAGE
- FAST INTERNET ACCESS
- ENOUGH FOOD FOR ALL
- SUSTAINABLE PLASTIC MATERIALS
- NEW BATTERY TECHNOLOGIES
- ENERGY-EFFICIENT VEHICLES
- TREATMENT FOR SERIOUS MEDICAL CONDITIONS
- REVOLUTIONARY HEALTHCARE

ENOUGH FOOD FOR ALL

FungiAlert, a company set up by two EPSRC-supported PhD students to bring their research to market, has developed a unique device for the early detection of plant disease.

The award-winning technology is the brainchild of Kerry O'Donnelly and Angela de Manzano, former students at the EPSRC Centre for Doctoral Training in Chemical Biology at Imperial College London.

The low-cost disposable device can detect the presence of soil- and water-borne plant pathogens before infection occurs – the only in-field device capable of doing so. The technology could become a key weapon against the highly destructive Phytophthora pathogen, estimated to account for up to US$7 billion of worldwide crop failure annually.

The team are working with the UK agricultural sector to ensure its products are suitable for all agricultural crops and for different farming practices and were recently granted Innovate UK funding to develop new diagnostic sensors.

SUSTAINABLE PLASTIC MATERIALS

It is estimated that whenever many people around the world take a shower the products they use to wash with can result in 100,000 plastic 'microbeads' entering the ocean, contributing to the eight million tonnes of plastic that reach the sea every year.

Microbeads are little spheres of plastic less than 0.5 mm in size that are added to personal care and cleaning products including cosmetics, sunscreens and fillers to give them a smooth texture.

Now, scientists and engineers from the University of Bath have developed a way to produce a biodegradable renewable alternative to plastic microbeads in a scalable, continuous manufacturing process. The beads come from a sustainable cellulose source and could potentially replace harmful plastic ones that contribute to ocean pollution.

The research team, from the university's EPSRC-funded Centre for Doctoral Training in Sustainable Chemical Technologies, is led by Professor Janet Scott, who is also the centre's training director. The team have received follow-on funding from EPSRC to develop their research with industrial partners.

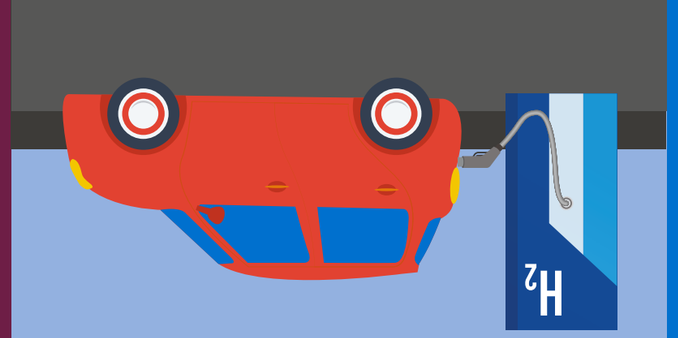
NEW BATTERY TECHNOLOGIES

Professor Clare Grey, from the University of Cambridge, a co-founder of the Faraday Institution, has pioneered the development of new battery technologies including a prototype lithium air battery. The battery enables lithium ions to move at rates that far exceed those of typical electrode materials – equating to a much faster-charging battery.

The breakthrough came from Professor Grey's application of nuclear magnetic resonance inspection techniques to the field of materials science. Her methodology makes it possible to monitor structural changes that occur during the operation of a battery, leading to an understanding of how batteries charge and discharge.

In addition to new battery technology, the research helped identify the physical properties of a number of technologically important materials.

ENERGY-EFFICIENT VEHICLES



Fundamental EPSRC-supported research at the University of Surrey, led by Dr Donald Highgate in the 1990s, underpinned the formation of ITM Power, a highly successful UK supplier of renewable energy. Among a range of initiatives, the company is rolling out hydrogen vehicle refuelling stations across the UK and has also fuelled hydrogen-powered buses as part of its move into the international hydrogen bus market.

The research behind ITM Power began with a small grant to develop a new material for use in hydrogen fuel cells. The project built on a unique material that Dr Highgate had originally developed for soft contact lenses.

Today ITM Power employs over 70 people and is also a project partner on eight EPSRC-supported academic and industry research projects and with two EPSRC Centres for Doctoral Training.

TREATMENT FOR SERIOUS MEDICAL CONDITIONS

Research at the University of York, led by Professor Simon Duckett, could pave the way for a new generation of low-cost and portable MRI scanners to be used in GP surgeries and hospital wards.

MRI scanners create an image by detecting the magnetism of molecules inside the body. However, conventional systems are not very efficient, typically detecting one molecule in every 200,000. To generate a usable image, the scanners must use highly expensive superconducting magnets housed in dedicated facilities operated by specialist staff.

In an entirely new approach, the York team have developed a way to make molecules more magnetic by 'embedding' them in parahydrogen – a magnetic form of hydrogen gas. This makes them visible to lower-cost, less complex scanners equipped with much smaller magnets.

It is now theoretically possible that these magnetised, non-harmful substances could be injected into the body and visualised, transforming our ability to diagnose and treat diseases including cancer, diabetes and dementia.

REVOLUTIONARY HEALTHCARE

In August 2018, Ziylo – a spin-out company from the University of Bristol co-founded by Professor Anthony Davis – was acquired by global healthcare company Novo Nordisk in a deal worth £623 million.

Ziylo has developed an innovative technology platform which could lead to safer, more effective treatment of diabetes and benefit millions of people around the world.

Novo Nordisk aims to incorporate a groundbreaking glucose-binding molecule developed by Ziylo into a radical new type of insulin that makes it easier for diabetics to manage their condition and minimises the risk of potentially fatal episodes of hypoglycemia. The breakthrough comes out of 20 years of EPSRC-supported research at the university.

Vital work to optimise the molecule for use in the new insulin will be undertaken by Carbometrics, a new company co-founded by Professor Davis, whose 11-strong team includes former PhD students and postdoctoral students from the Davis Group.

The new treatment could be available to the global healthcare sector within 10 years.

WHY INVEST IN PHYSICAL SCIENCES?

Physics, chemistry and materials sciences – the physical sciences – study the inanimate natural objects, forces and properties around us.

By understanding the fundamental building blocks of our universe – heat, light, atoms, the elements, matter and gravity itself – physical scientists are unlocking its secrets and improving lives.

Physics concerns the basic principles that govern the physical world we live in. A fundamental understanding of light and optics led EPSRC-supported physicists to develop lasers that enable the internet to run at super-fast speeds and improve our access to data.

Chemists study the composition, structure and properties of elements and compounds. By investigating core reactions between elements and compounds, EPSRC-supported chemists have developed innovative ways to improve diagnostics and prevent disease.

Materials science considers the physics and chemistry of matter, and explores how different materials work together. Fundamental research by EPSRC-supported materials scientists led to the 'discovery' of wonder material graphene for which they were awarded the Nobel Prize in Physics in 2010.

One in every five pounds in the UK economy is dependent on developments in chemistry research. Physics-based businesses contribute £77 billion to the UK economy directly and account for one million jobs.

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EPSRC
Engineering and Physical Sciences Research Council

Investing in fundamental physical sciences research and innovation

ABOUT EPSRC

EPSRC is the main funding agency for engineering and physical sciences research in the UK. By investing in research and postgraduate training, we are building the knowledge and skills base needed to address the scientific and technological challenges facing the nation.

Working across a vast range of fields including mathematics, healthcare technologies, engineering and chemistry, the research we invest in has an impact on all sectors. It provides a platform for future UK prosperity by contributing to a healthy, connected, resilient and productive nation.

EPSRC is part of UK Research and Innovation.

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