ENABLING FUTURE APPLICATIONS

The Compound Semiconductor Applications Catapult is focused on helping UK industry exploit recent advances in compound semiconductor technologies, bringing innovative applications to life

Semiconductors are at the heart of almost all modern electronic devices. Silicon, the most common, has widespread commercial applications and is readily available. Compound semiconductors combine two or more elements to create capabilities that cannot be achieved with conventional silicon devices, delivering performance improvements in power, speed, latency and signal quality. This makes them ideal to use in areas such as energy efficiency, electrified and autonomous vehicles, mobile communications, new smart sensing devices for the internet of things and 5G applications. They will contribute towards the four grand challenges identified in the Government's Industrial Strategy – ageing society, the future of mobility, clean growth and artificial intelligence with the data economy.

In the past, compound semiconductors have not seen widespread commercial applications or high-volume production associated with silicon because they were difficult to make.

However, as the cost of manufacturing continues to fall, their special properties mean they will become ever more important in enabling demanding future applications.

Enabling the future

The laser was invented in 1960, but commercialisation only took off in the 1980s with the development of compound semiconductor lasers in CD and DVD players. 'Vertical cavity surface emitting lasers' (VCSELs) will drive further innovation with gesture recognition, creating new user interfaces for smart phones and numerous possibilities for virtual reality and augmented reality.

Silicon solar cells convert 25% of the sun's energy into electrical power, losing the remaining 75%. Compound semiconductor solar cells generate nearly twice the power, providing a clean and renewable energy source with fewer solar farms.

The electricity generated by wind turbines and solar farms cannot be fed into the national grid without being synchronised using power electronics, which currently introduce losses of 10-20%. Compound semiconductors reduce the losses to a few percent, delivering more power to the grid with fewer turbines or solar panels.

An electric engine built with silicon semiconductors is around 75% efficient, it requires liquid cooling and weighs around 150kg. Compound semiconductors will work with new battery technologies to improve the efficiency of electric engines, reduce their weight and extend the vehicle range by up to 2x.

Compound semiconductors enable us to see a broad spectrum of colours, from infrared to ultraviolet, through a process called 'hyperspectral imaging'. This technique will improve the detection of age-related illnesses, such as cancer, with improved outcomes for society. The same technology can be applied to threat detection at airports, leading to safer travel.

The 5G network will use compound semiconductors to provide 100 billion connections with a latency of 1ms and 10Gbps bandwidth. This will cope with the demands of social media and is high enough for 4k streaming and autonomous vehicles of the future.

The Catapult Network

The Compound Semiconductor Applications (CSA) Catapult is the 10th addition to the UK's catapult network, the other catapult's being: High Value Manufacturing, Cell and Gene Therapy, Satellite Applications, Digital, Offshore Renewable Energy, Future Cities,

COMPOUND SEMICONDUCTOR APPLICATIONS CATAPULT

The Compound Semiconductor Applications Catapult is a world-class, open access R&D facility to help UK businesses exploit advances in compound semiconductor technologies across key application areas such as healthcare, the digital economy, energy, transport, defence and security, and space. Its aim is to create economic growth, increased productivity and improved employment outcomes across the UK.

COMPOUND SEMICONDUCTOR APPLICATIONS CATAPULT

DR ANDY SELLARS, CHIEF BUSINESS DEVELOPMENT OFFICER

Transport Systems, Energy Systems and Medicines Discovery.

Catapults are open-access research and technology organisations (RTOs) designed to help UK companies gain access to growing global markets in specific technology areas. In the case of the CSA Catapult, we offer a collaborative design studio, laboratories and expertise for companies to develop products using next generation semiconductors.

The UK is uniquely positioned to exploit recent advances in compound semiconductor technologies. We have a legacy of academic investments in semiconductor applications, which exceed £750million over 10 years, funded by the Engineering and Physical Research Council (EPSRC). We have around 5,000 companies that manufacture electronic systems, many of which will benefit from next generation semiconductors.

The CSA Catapult is located in the heart of the world's first compound semiconductor cluster in South Wales. This cluster includes the Institute for Compound Semiconductors, hosted at Cardiff University, the Future Compound Semiconductor Manufacturing Hub at Cardiff University and the Compound Semiconductor Centre. Together with surrounding companies, the cluster spans the supply chain from material processing to semiconductor devices and systems.

Since our launch in early 2018, the CSA Catapult has engaged with over 600 companies across the UK through conferences, exhibitions and company visits. We have partnered with over 60 organisations, offering support on their projects, and we are open to further collaborations with innovative companies.

Strategy

In November 2017, the Government launched the Industrial Strategy, which aims to boost productivity and grow the economy through R&D investment, with a target of 2.4% of GDP, or £4.7billion over 4 years. This strategy is supported by the Industrial Strategy Challenge Fund (ISCF), which seeks industry-led challenges to build on emerging and established strengths and create industries of the future – addressing society-changing opportunities and global mega-trends. The first wave of ISCF included the £246million Faraday Challenge to scale up battery manufacturing in the UK.

The CSA Catapult has taken a leading role in shaping future ISCF programmes that involve power electronics, RF and microwave, photonics and sensors. As part of our strategy, we aim to scale GaN and SiC production in the UK through supply chain initiatives, supporting electric vehicles, smart energy grids and 5G infrastructure.

To support this strategy, the CSA Catapult is developing a range of evaluation modules (EVMs) to showcase next generation semiconductors. Our first wave of EVMs will include a SiC demonstrator for automotive, battery charging and energy conversion applications. We plan to develop a beam forming EVM to showcase advanced 5G capabilities, and a LiDAR EVM for collision avoidance applications in autonomous vehicles. These EVMs will enable companies to accelerate their product development plans whilst driving the demand for high volume semiconductor devices through UK fabs.

> As the cost of manufacturing compound semiconductors continues to fall, their special properties mean they will become ever more important in enabling demanding future applications.

These EVMs are just one way in which we can help UK companies gain access growing global markets.

The CSA Catapult is open to collaborate with innovative UK companies on EVMs or other projects of scale, and companies wishing to get involved are encouraged to contact us at: www.csa.catapult.org.uk

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