electricity
unlocking the power

Electricity has transformed our society and quality of life. But now it is time to transform our electricity supply to achieve policy targets driven by climate change and energy security. Developments in semiconductor technology have already improved the efficiency of electrical energy conversion, but there is further potential for efficiency gains. To realise this, a unique semiconductor cleanroom has been established at the University of Warwick, supported by funding from Advantage West Midlands and the European Regional Development Fund as part of the Birmingham Science City Research Alliance (SCRA).

The specialised laboratory includes a semiconductor Class 1000 cleanroom, humidity controlled, with a yellow room for photolithography capable of one micron lithography and a suite of processing equipment. The laboratory provides for research into the materials physics and device fabrication technology of silicon carbide. It also functions as an incubator unit for development of new device concepts and prototype devices for the power electronics systems community, both academic and industrial.

Silicon carbide (SiC) offers major advantages in electronics due to its exceptional material properties. SiC is able to operate at much higher voltages and temperatures than silicon. The SiC devices enable a substantial reduction in the size and weight of power electronic modules wherever they are used because of their high power efficiency and the ability to run at higher frequencies and temperatures than Si devices. There are numerous potential applications in various sectors including: power generation, power conversion, aerospace and automotive and smart grid development.

The processing equipment includes:

- High temperature furnace: a unique custom vertical design aimed at high quality gate oxides on SiC in a new temperature regime up to 1500°C and implant annealing 100 mm wafers in Argon up to 1800°C
- A metal contact formation furnace capable of 1000°C specifically for SiC processing
- Inductively coupled plasma dry etcher: low ion energy for good mask selectivity and minimum physical damage, but high rate etching of SiC, Si, SiO_2, Si_3N_4 using fluorinated gases
- Low Pressure SiO_2 deposition: a TEOS based system which will deposit high quality field oxides to avoid the need to grow thick oxides on SiC
- A 1:1 stepper and associated coater/developer capable of 0.75 micron lithography

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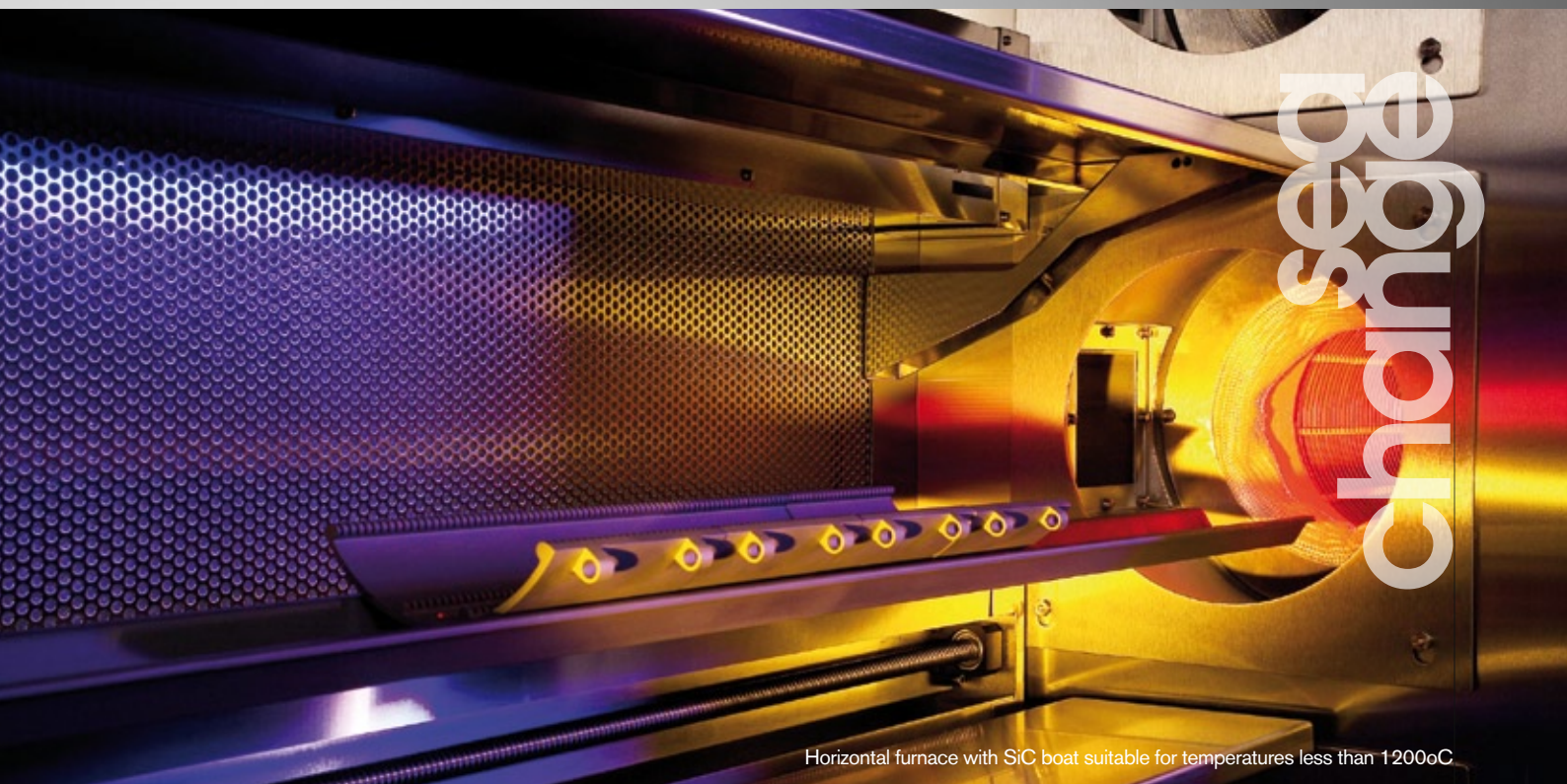

Horizontal furnace with SiC boat suitable for temperatures less than 1200oC

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- An advanced stylus based physical film thickness monitor using an optical lever and an industrial quality ellipsometer to measure the optical constants of the SiC system and optical film thickness
- An analytical microscope with a high quality CCD camera and image processing software
- Extracted solvent and acid benches for wafer cleaning and other operations

The Power Electronics Applications in Energy Research Group (PEATER) was founded in 2005 by Professor Philip Mawby, to establish a world-class centre for research into power electronics, power semiconductor devices and applications in power systems and power conversion. Professor Mawby has built an international reputation in the area of power electronics and power device research. His main interests are materials for new power devices, modelling of power devices and circuits, power integrated circuits. The area of efficient electrical energy conversion has become critical in the development of renewable energy systems, sustainable transport and many other applications. The team also includes: Dr Mike Jennings a Research Fellow undertaking research into silicon carbide power devices; Dr Peter Ward who has had an extensive industrial career in the field of silicon technology.

This group has active industrial and academic collaborations running in the fields of Aerospace, Semiconductor Research, Automotive, power integrated circuits development and renewable energy. These include: automotive companies Jaguar Land-Rover, Toyota, Zytek, Prodrive, Ricardo and Lotus; in the energy sector Converteam, Areva, and in the aerospace sector GE Aviation, Goodrich, as well as device companies Semelab, Westcode, and NXP.

The set up of this new facility is part of the £10.5m Energy Efficiency & Demand project,funded by AWM and ERDF under the Birmingham Science City initiative. It is a key part of a larger investment in the research infrastructure of the West Midlands region, which unites the Universities of Warwick and Birmingham in a newly-formed Science City Research Alliance (SCRA). The Energy Efficiency and Demand project, led by the University of Warwick, sits alongside the Hydrogen project, led by the University of Birmingham, under the umbrella of the Energy Futures theme. The investment aims to develop and promote a regional hub for academic and industrial expertise in energy efficiency and demand reduction as part of the Government's mission to achieve a strong knowledge-based economy.

The laboratory is available for use, with support of the PEATER team, by experts from academia or industry wanting to develop or test devices. The team is also looking for opportunities to collaborate with interested companies or academics, particularly from the West Midlands region.

Prof. Philip Mawby – Head of Power Electronics Applications in Energy Research Group (PEATER)

Inspecting semiconductor materials

For further information and business enquires, including proposals for collaboration or access to the facilities:

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