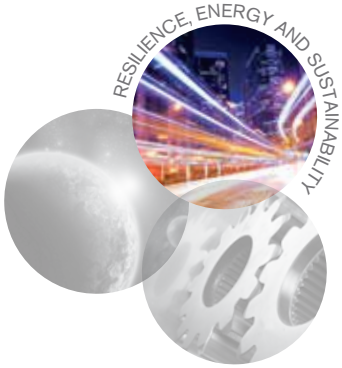
UNIVERSITY OF BIRMINGHAM

Materials Chemistry and Energy

TARGETING THE NEXT GENERATION OF MATERIALS TO MEET THE GRAND CHALLENGES IN ENERGY STORAGE AND PRODUCTION

‘We use theoretical and experimental tools to understand and improve the properties of materials, and design and discover new materials, for applications in energy and sustainability.’

Dr Paramaconi Rodriguez, Birmingham Fellow in Chemistry



College of Engineering and Physical Sciences Research

MATERIALS CHEMISTRY AND ENERGY

The UK Government has identified eight great technologies of the future that need investment in order to drive economic growth. Advanced materials and energy are two of them. And that is what we do at Birmingham – at the very cutting edge. Although our research underpins a range of industrially important areas, a major focus is on new materials for energy technologies. Efficient energy storage and production is a huge challenge facing our society, and to meet it requires innovation and a change in direction. Our research is targeted at the next generation of materials for hydrogen storage, fuel cell, battery, solar cell and nuclear industries.

For example, in collaboration with chemical engineers and materials scientists, our chemists are helping to develop fuel cells that can efficiently convert chemical energy from a fuel into electricity through chemical reactions.

The limitations and costs of sustainable energy technologies are associated mainly with the intrinsic performance of the materials. Our research is underpinned by fundamental experimental and computer-modelling studies into the role that the chemical structure plays in dictating the underlying properties of materials, leading to strategies for the rational design of new materials with improved properties.

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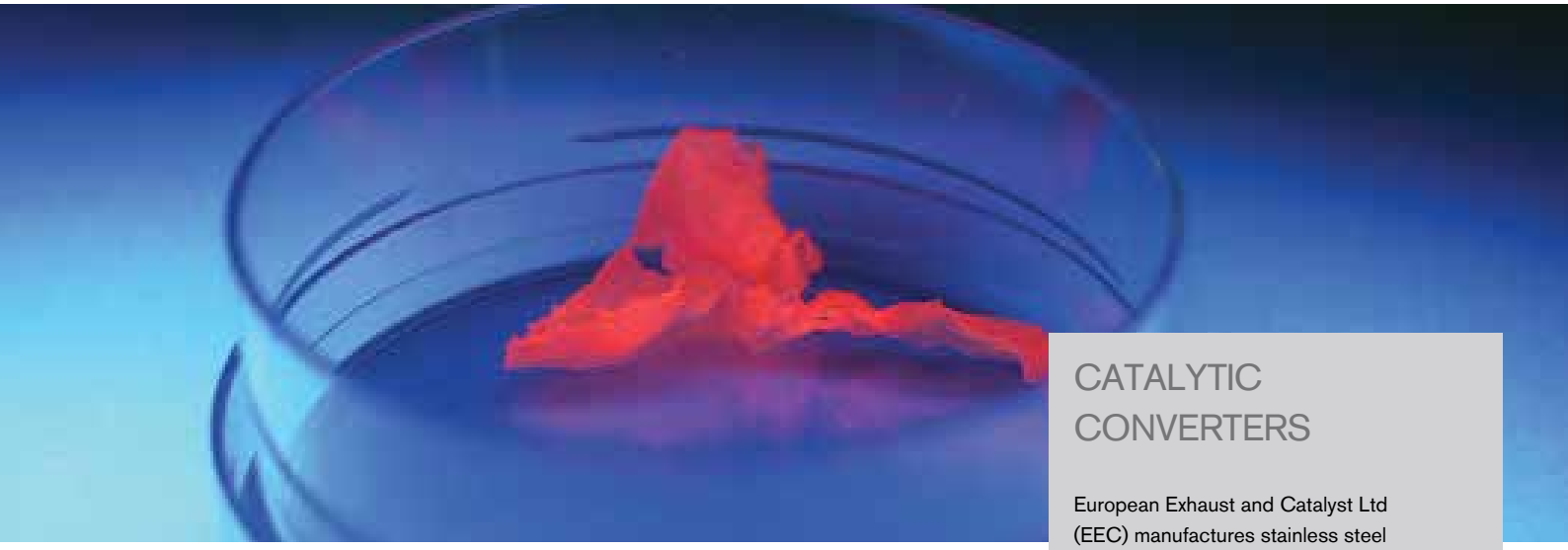
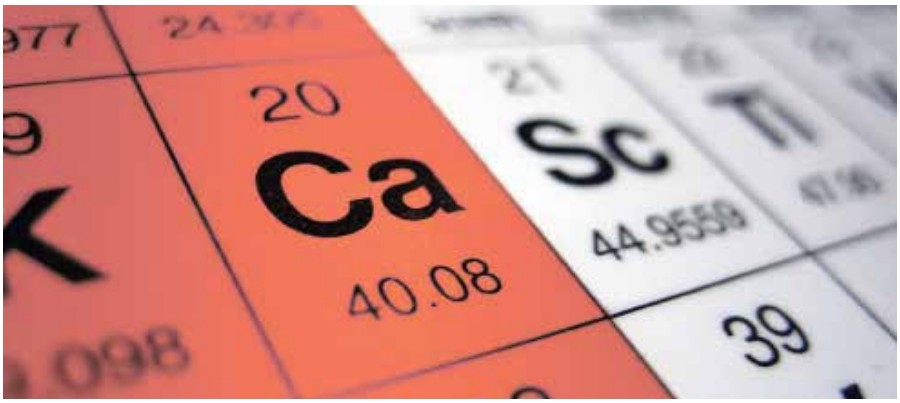


INDUSTRIAL COLLABORATIONS AND OPPORTUNITIES

Our main goal is to deliver research to companies and public bodies involved in energy use and management. At Birmingham, we have a Centre for Doctoral Training in 'Fuel Cells and their Fuels – Clean Power for the 21st Century', funded by the EPSRC and supported by the Midlands Energy Consortium. We are also home to the Birmingham Centre for Nuclear Education and Research, launched in 2010 to provide the nuclear expertise and capacity to support the UK's investment in the nuclear power sector.

Even at undergraduate level, we strongly promote engagement with industry. Our flagship 'Chemistry with Industrial Experience' Masters degree, with a one year industrial placement, is one of our most successful courses and involves around 30 companies. This culture of industrial engagement is equally embedded in our current research portfolio, which is supported by internationally renowned organisations such as Johnson Matthey and the National Nuclear Laboratory.

Energy research is one of six cross-council strategic priority areas for Research Councils UK (RCUK). Our research groups work together to address the urgent needs for materials design and characterisation in the fields of energy generation and conversion, power electronics and energy conservation. Our research groups are interested in the development and application of methods suitable for use in a more industrial setting and on large scales.



BIRMINGHAM ENERGY INSTITUTE

The Birmingham Energy Institute brings together over 140 academics engaged in energy and energy related research and development at the University with over £75 million external project funding. The Institute is the focal point for the University and its national and international partners, to create change in the way we deliver, consume and think about energy.

CATALYTIC CONVERTERS

European Exhaust and Catalyst Ltd (EEC) manufactures stainless steel catalytic converters and recently turned to Birmingham to help with the evaluation of the coatings it was using in its manufacturing process. Catalytic converters consist of a substrate, or monolith, that is coated with a layer containing precious metals such as platinum, palladium, rhodium and rare earths. It is these elements that convert pollutants in car exhaust systems to less harmful products such as carbon dioxide or water.

A recent analysis by EEC of its production chain showed that the company could gain better value by using substrates originating from China or the USA and applying a coating of the active materials themselves. Initially, however, EEC encountered variability in the production coatings it was using, leading to costly over-specification of catalyst solution to achieve the emission levels required.

Making use of the School's extensive materials characterisation equipment, the company was able to identify changes that were needed in its processes. Notably, it discovered the beneficial effects of reducing the particle size within its coatings from 10 µm down to 2 µm. Based on these findings, EEC invested in new processing equipment, resulting in more effective and durable catalyst coatings.

'The equipment and expertise of the team in chemistry at Birmingham has been invaluable and a real benefit to our business,' said Jim Slade, Director of Operations for EEC. 'We look forward to continuing this relationship to validate, control and refine current technology and develop catalyst technology for our future projects.'

OUTSTANDING FACILITIES

We have a vast range of facilities in Chemistry at the University of Birmingham, including the Centre for Chemical and Biochemical Analysis, to provide the very highest quality of data analysis. Through our excellent facilities and high levels of technical expertise, we can offer a rapid turnaround of data to suit the individual requirements of both the academic community and external commercial organisations.

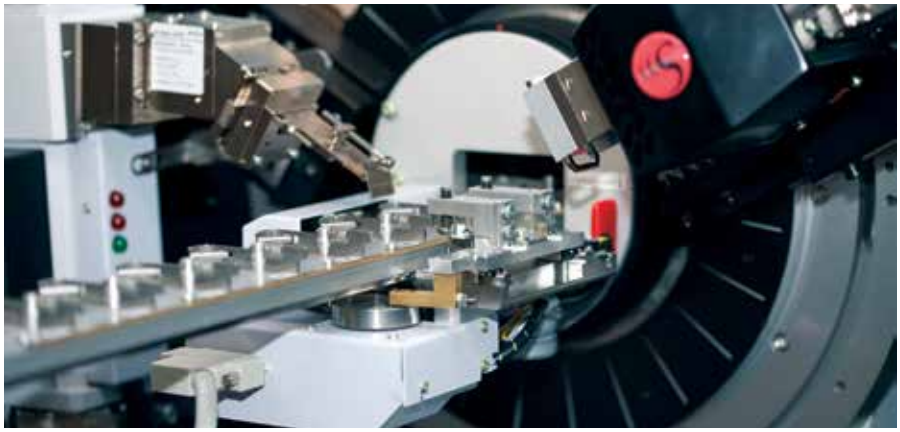
The X-ray diffraction facility is equipped with state-of-the-art diffractometers offering both single crystal, powder X-ray diffraction and X-ray fluoresce analysis. Our instruments enable rapid data collection and structure determination over a wide range of temperatures.

The mass spectrometry laboratory offers an extensive range of techniques and ionisation methods that include: electron ionisation (EI), chemical ionisation (CI) and GC/MS, LCMS, electrospray (ES)/APCI, accurate mass measurement, liquid secondary ionisation mass spectrometry (LSIMS) and matrix assisted laser desorption ionisation (MALDI).

Our well-equipped **NMR laboratories** house five spectrometers, allowing automated and fast turnarounds of multinuclear 1H, 13C, 19F and 31P spectra. Demanding multi-pulse experiments as well as variable temperature experiments can also be performed.

Our **chromatography laboratory** offers GC and HPLC (including prep, semi-prep and analytical) and we also provide elemental analysis for compounds containing carbon, hydrogen, nitrogen and sulphur.

Additionally, we have a wide range of **electrochemical characterisation** methods that provide battery and fuel cell developers with an accurate evaluation of the performance of the materials in fuel cells and batteries. Various microscopy techniques (eg, AFM, TEM) are also available across the University campus and through our collaborations for materials characterisation.



Learn more

chemistry4business@contacts.bham.ac.uk
www.birmingham.ac.uk/chemistry

CHEMISTRY

Our leading research in chemistry focuses on health, energy and sustainability, mapping squarely onto pressing national and global issues. By working at the interface of several disciplines as well as being strong in fundamental areas of theoretical and experimental chemistry, our research is creating real societal impact.

The University of Birmingham has one of the largest and diverse concentrations of science expertise in the UK and therefore we can offer our students and researchers unique opportunities for interdisciplinary study in a subject central to the new challenges facing the world today.

A KEY CONTRIBUTOR TO BROAD RESEARCH THEMES:
Chemistry is a core component of the College of Engineering and Physical Sciences. The College's portfolio of research capabilities and achievements can be summarised in three key overarching themes: Advanced Manufacturing; Science Frontiers; and Resilience, Energy and Sustainability. In this area, our research is driving both the technology and thinking required to solve some of the grand challenges facing the UK. Our ability to combine the practical with the radical has placed Birmingham at the forefront of this endeavour.

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