

## Chemical Engineering PhD (Speciality Products specialism)

Postgraduate PhD doctoral research degree in Chemical Engineering PhD/MSc by research (Speciality Products specialism):

This theme is concerned with the development of products and processes for advanced materials such as paints, pigments, electronics, ceramics, polymers and pharmaceuticals.

It incorporates the following research groups: Materials processing; Innovative minerals processing; Supercritical fluids; and Catalysis and chemical reaction engineering.

Chemical Engineering is dynamic and evolving. It provides many solutions to problems facing industries in the pharmaceutical, biotechnological, oil, energy and food and drink sectors. It is vital to many issues affecting our quality of life; such as better and more economical processes to reduce the environmental burden, and more delicious and longer lasting food due to the right combination of chemistry, ingredients and processing.

Birmingham is a friendly, self-confident, School which has one of the largest concentrations of chemical engineering expertise in the UK. The School is consistently in the top five chemical engineering schools for research in the country.

It has a first-class reputation in learning, teaching and research, and is highly placed in both *The Guardian* and *The Times* league tables. The School was recently awarded the **Queen's Anniversary Prize for Higher Education**.



**[Study here and find out why the University of Birmingham was awarded The Times and The Sunday Times University of the Year 2013-14 \(http://www.birmingham.ac.uk/news/latest/2013/09/20-sep-Birmingham-announced-as-University-of-the-Year.aspx\)](http://www.birmingham.ac.uk/news/latest/2013/09/20-sep-Birmingham-announced-as-University-of-the-Year.aspx)**

### Course fact file

**Type of Course:** Doctoral research

**Study Options:** Full time, part time

**Duration:** PhD: 3 years full-time; MPhil: 1 year full-time, 2 years part-time

**Start date:** Research degrees can start at any time by agreement with the supervisor

### Related courses

**[Research degrees - School of Chemical Engineering \(/schools/chemical-engineering/postgraduate/research-degrees.aspx\)](/schools/chemical-engineering/postgraduate/research-degrees.aspx)**

### Contact

Admissions Tutor: Prof Mark Simmons

**Contact us online (<http://bham.hobsons.co.uk/ask.aspx?cid=1223&did=24>) or at +44 (0)121 414 3947.**

**[School of Chemical Engineering \(/schools/chemical-engineering/index.aspx\)](/schools/chemical-engineering/index.aspx)**

### Details

This theme is concerned with the development of products and processes for advanced materials such as paints, pigments, electronics, ceramics, polymers and pharmaceuticals, and incorporates the following research groups:

- **[Materials processing \(#materials\)](#)**

- **Innovative minerals processing (#innovative)**

- **Supercritical fluids (#supercritical)**

- **Catalysis and chemical reaction engineering (#catalysts)**

We work closely with the Positron Imaging Centre, which is run jointly with the School of Physics and Astronomy, and has attracted funding of more than £2 million for new equipment in the last five years. Positron Emission Particle Tracking, which was invented at Birmingham, enables product–process interactions to be observed directly in opaque systems by following single particle tracers down to 60µm in size. The technique has enabled the first detailed generic studies of solids motion in fluidized beds (with EPSRC, BP and Unilever), rotating drums and kilns (EPSRC/Huntsman), and paste flows. Novel applications include studies of agglomeration (Unilever), particle coating (Merck Sharp & Dohme), and mixing in polymer processing (EU consortium).

## **Research groups**

### **Materials processing**

Materials processing research takes place in conjunction with the IRC in Materials Processing and the £8 million Net Shape Manufacturing Laboratory, and is concerned with the forming of metals, ceramics and ceramic composites with low defect densities and controlled microstructures, in order to produce products of reliable and reproducible properties. These materials may find functional or structural applications.

Central to our work is the investigation of product–process relationships: the way in which the functional properties of the formed product are related to the properties of the starting materials and their processing routes. There are close links with the particle and solids processing research listed above.

Major research areas include:

- Modelling paste flows in complex systems
- Development of theories and practices for plastic forming methods
- Fabrication of complex net shapes from particulates
- Development of theories of flow and relaxation in powder suspensions and pastes
- Zero-defect forming of novel materials
- Ceramic drying and sintering procedures
- Forming of particulate catalyst supports
- Electromechanical devices (with the Functional Ceramics group of the IRC)
- Casting (with the Process Modelling and Casting groups of the IRC)
- Fluid flows in aluminium forming

### **Innovative minerals processing**

Innovative minerals processing is concerned with more efficient use of mineral resources and reduction in environmental pollution. Our work covers minerals separation processes, metals recycling and coal treatment. We run an international centre of excellence for microwave processing of minerals: coal, ilmenite, copper and gold ores, with sponsors including the EU, EPSRC and Rio Tinto. We have also developed novel recycling methods for aluminium from secondary drosses in UK landfills, resulting in a pilot plant running in Staffordshire.

Major research areas include:

- Biohydrometallurgical leaching and modification
- Efficient separation of minerals from low-grade ores
- Thermally assisted liberation of minerals
- The effect of microwave radiation on minerals
- Recycling of metals
- Desulphurisation of coal prior to combustion Improvement in bulk solids handling, such as control of segregation

### **Supercritical fluids**

Supercritical fluids research is concerned with the use of such fluids (mainly carbon dioxide, water and tetrafluoroethane) as solvents for extraction of natural products from plant resources; for selective rapid separation of fine solid products, such as pharmaceuticals; and as media for chemical and biochemical reactions. Supercritical fluids provide ideal benign and environmentally friendly media with which to carry out the above processes in a greener and cleaner way, with a reduced number of processing and recovery steps. This is the largest such group working within an engineering department in the UK.

Current work includes:

- Extraction and isolation of essential oils, lipids and value-added fatty acids from plant material such as herbs and algae
- Generation of particles of controlled size and morphology by rapid expansion of supercritical solutions (RESS) or by using supercritical fluids as antisolvents (GAS)
- Regeneration of high quality adsorbents by reversible adsorption/desorption using supercritical carbon dioxide as regenerant
- Polymer reactions in supercritical fluids (with the University of Melbourne, Australia)
- Pharmaceutical wastewater treatment by oxidation in supercritical water
- Gasification of biomass in supercritical water
- Production of β-lactam antibiotic intermediates by immobilised enzyme hydrolysis, in compressed tetrafluoroethane
- Design and scale-up of industrial processes in supercritical carbon dioxide

Research in all these areas is concerned with the fundamental and engineering aspects of system kinetics, equilibrium, reactor design and prediction of the reactor performance.

## Catalysis and chemical reaction engineering

Catalysis and chemical reaction engineering lie at the core of many chemical and biochemical processes: This group is one of very few in the UK capable of working all the way from fundamental catalyst design, through formulation and catalyst manufacture, to operational issues and reactor design.

We are particularly concerned with design of catalysts and reactors for high selectivity and therefore better environmental performance.

Industrial sponsors include the world's second largest catalyst company, Johnson Matthey, as well as numerous operating companies such as BP and Unilever. We are part of a new multi-million pound programme with EPSRC, Johnson Matthey and a consortium of university collaborators aimed at achieving 100% selectivity in catalytic processes for hydrogenation, dehydrogenation and oxidation.

Current projects include:

- Studies of hydrogenation reactions in novel bubble columns, patented at Birmingham
- Studies of hydrogenation, dehydrogenation and oxidation on supported catalysts
- Achievement of better selectivity/mass transfer in microreactors
- Packed bed catalytic reactors for hydrogenation
- Novel twin-screw extruders with surface-catalytic action
- Novel catalysts, catalyst design and characterisation
- Polymer reactions in supercritical fluids (in conjunction with the Supercritical Fluids group)

## Related links

[School of Chemical Engineering \(/schools/chemical-engineering/index.aspx\)](/schools/chemical-engineering/index.aspx)

## Fees and funding

[Standard fees \(/postgraduate/dr-fees/tuition.aspx\)](/postgraduate/dr-fees/tuition.aspx) apply, [contact the School \(mailto:pg-admis-chem-eng@bham.ac.uk\)](mailto:pg-admis-chem-eng@bham.ac.uk) for further information.

Learn more about [fees and funding \(/postgraduate/dr-fees/index.aspx\)](/postgraduate/dr-fees/index.aspx)

## Scholarships and studentships

EPSRC and BBSRC studentships are available for PhDs. Other sources of funding are the Knowledge Transfer Partnership (KTP), the European Union and industrial funding for UK and EU students.

International students can often gain funding through overseas research scholarships, Commonwealth scholarships or their home government.

For further information contact the School directly or email [sfo@contacts.bham.ac.uk \(mailto:sfo@contacts.bham.ac.uk\)](mailto:sfo@contacts.bham.ac.uk)

## Entry requirements

The normal entry qualification for PhD study is either at least an upper second-class Honours degree, or a first degree of a lower classification, along with an MSc or evidence of substantial relevant industrial experience.

Learn more about [entry requirements \(/postgraduate/requirements-dr/step1.aspx\)](/postgraduate/requirements-dr/step1.aspx).

## International students

We accept a range of qualifications from different countries – learn more about [international entry requirements \(/postgraduate/requirements-dr/step1.aspx\)](/postgraduate/requirements-dr/step1.aspx).

[Standard English language requirements \(/postgraduate/requirements-pgt/international/index.aspx\)](/postgraduate/requirements-pgt/international/index.aspx) apply.

## How to apply

Learn more about [applying \(/postgraduate/requirements-dr/index.aspx\)](/postgraduate/requirements-dr/index.aspx)

When clicking on the Apply Now button you will be directed to an application specifically designed for the programme you wish to apply for where you will create an account with the University application system and submit your application and supporting documents online. Further information regarding how to apply online can be found on the [How to apply pages](#) (<http://www.birmingham.ac.uk/students/courses/postgraduate/apply-pg/index.aspx>)

[Apply now \(https://pga.bham.ac.uk/lpages/EPSo20.htm\)](https://pga.bham.ac.uk/lpages/EPSo20.htm)

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## Related links

[Postgraduate degree courses - School of Chemical Engineering \(/schools/chemical-engineering/postgraduate/index.aspx\)](/schools/chemical-engineering/postgraduate/index.aspx)

[Research vacancies and studentships at the School of Chemical Engineering \(/schools/chemical-engineering/postgraduate/research-vacancies-studentships.aspx\)](/schools/chemical-engineering/postgraduate/research-vacancies-studentships.aspx)

## Related news and events

[University of Birmingham wins Queen's Anniversary Prize for Higher Education \(/news/latest/2011/11/queens-prize.aspx\)](/news/latest/2011/11/queens-prize.aspx)

## Research interests of staff

Our mission is to carry out research of the highest academic quality, which is novel, challenging and relevant to users.

Our strengths are in design and characterisation of microstructured products, and in heat and mass transfer, fluid flow, particle technology and materials engineering across chemical, biological and physical systems. We collaborate with world-class industry, and with leading edge engineering and science departments nationally and internationally.

## Research centres

### The Centre for Formulation Engineering

The Centre's mission is to carry out research of the highest academic quality, which is novel, challenging and relevant to users. Particular strengths are in design and characterisation of microstructured products, and in heat and mass transfer, fluid flow, particle technology and materials engineering across chemical, biological and physical systems. We collaborate with world-class industry, and with leading edge engineering and science departments nationally and internationally.

### Interdisciplinary Research Centre in Materials Processing - IRC

The primary objective of the research programme in the Interdisciplinary Research Centre (IRC) is the development of materials, through materials processing and of manufacturing technologies so that the properties of the materials are fully exploited. Close interaction with industry is an essential part of this philosophy. The programmes that are in operation with industry vary from long term projects to short term problem-solving.

## Related research

- [Speciality Products - Formulation Engineering Research - School of Chemical Engineering \(/research/activity/chemical-engineering/speciality-products/index.aspx\)](/research/activity/chemical-engineering/speciality-products/index.aspx)
- [The Centre for Formulation Engineering \(/research/activity/chemical-engineering/index.aspx\)](/research/activity/chemical-engineering/index.aspx)

## Employability

### University Careers Network

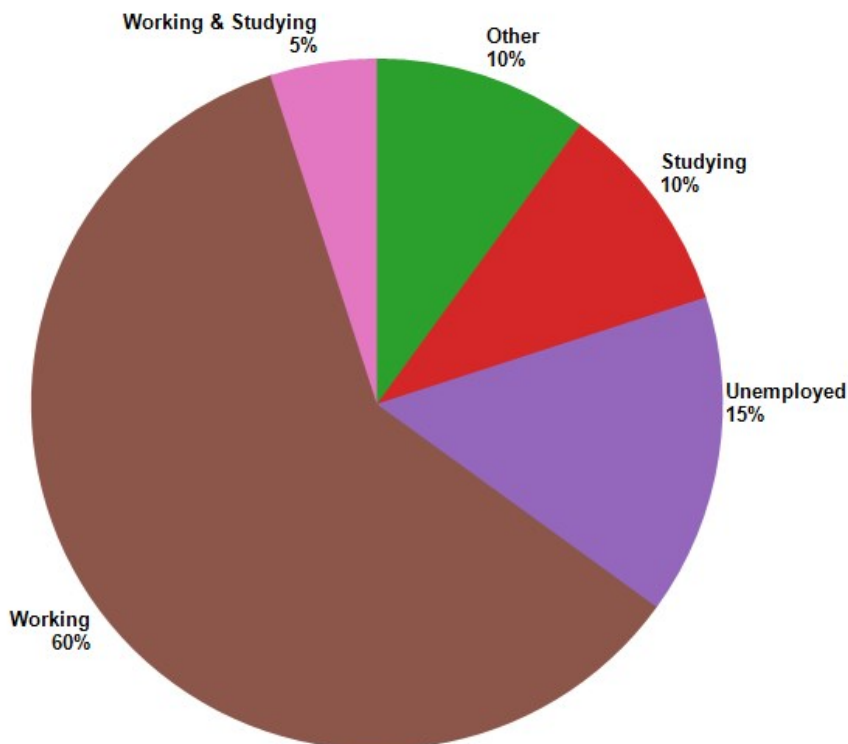
Preparation for your career should be one of the first things you think about as you start university. Whether you have a clear idea of where your future aspirations lie or want to consider the broad range of opportunities available once you have a Birmingham degree, our Careers Network can help you achieve your goal.

Our unique careers guidance service is tailored to your academic subject area, offering a specialised team (in each of the five academic colleges) who can give you expert advice. Our team source exclusive work experience opportunities to help you stand out amongst the competition, with mentoring, global internships and placements available to you. Once you have a career in your sights, one-to-one support with CVs and job applications will help give you the edge.

If you make the most of the [wide range of services \(https://intranet.birmingham.ac.uk/as/employability/careers/college/eps/index.aspx\)](https://intranet.birmingham.ac.uk/as/employability/careers/college/eps/index.aspx) you will be able to develop your career from the moment you arrive.

### Destinations of Leavers from Higher Education (DLHE) 2011/12 (postgraduate taught graduates)

The DLHE survey is conducted 6 months after graduation.



#### Examples of employers:

- BP
- British Gypsum
- Citi
- Coca-Cola
- Foster Wheeler Energy
- Jacobs Engineering
- Johnson Matthey
- KBR
- Pepsico
- RBC Capital Markets

#### Examples of occupations:

- Chemical Engineer
- Development Engineer
- Finance Analyst
- Market Analyst
- Performance Engineer
- Process Engineer
- Process Development Technologist
- Process Support Engineer
- Team Leader
- Test and Validation Engineer

#### Further study - examples of courses:

- MRes Chemical Engineering Science

- MSc Advanced Chemical Engineering
- MSc Biochemical Engineering
- MSc Chemical Engineering
- PhD Chemical Engineering
- PhD Formulation Engineering
- PhD Regenerative Medicine

Visit the **Careers section of the University website** (<https://intranet.birmingham.ac.uk/as/employability/careers/college/eps/index.aspx>) for further information.

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