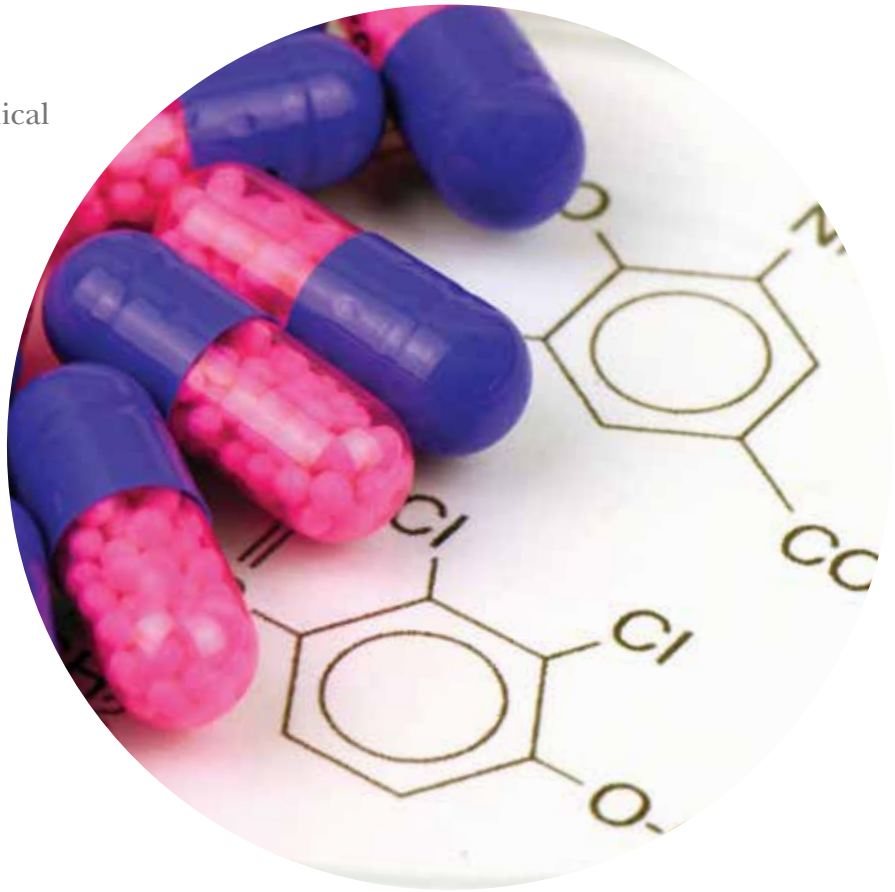
UNIVERSITY OF BIRMINGHAM

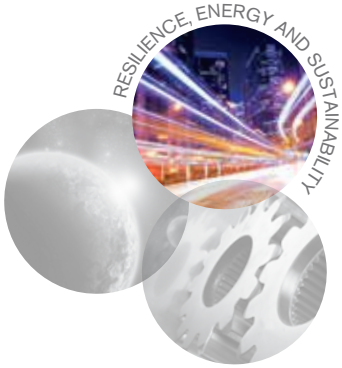
Chemical Biology and Drug Discovery

TRANSLATING FUNDAMENTAL CHEMISTRY INTO THERAPEUTIC ACTION

'We use our expertise in chemical synthesis to develop new drug candidates and to probe and mimic biological systems.'

Professor Nigel Simpkins,
Haworth Chair of Chemistry





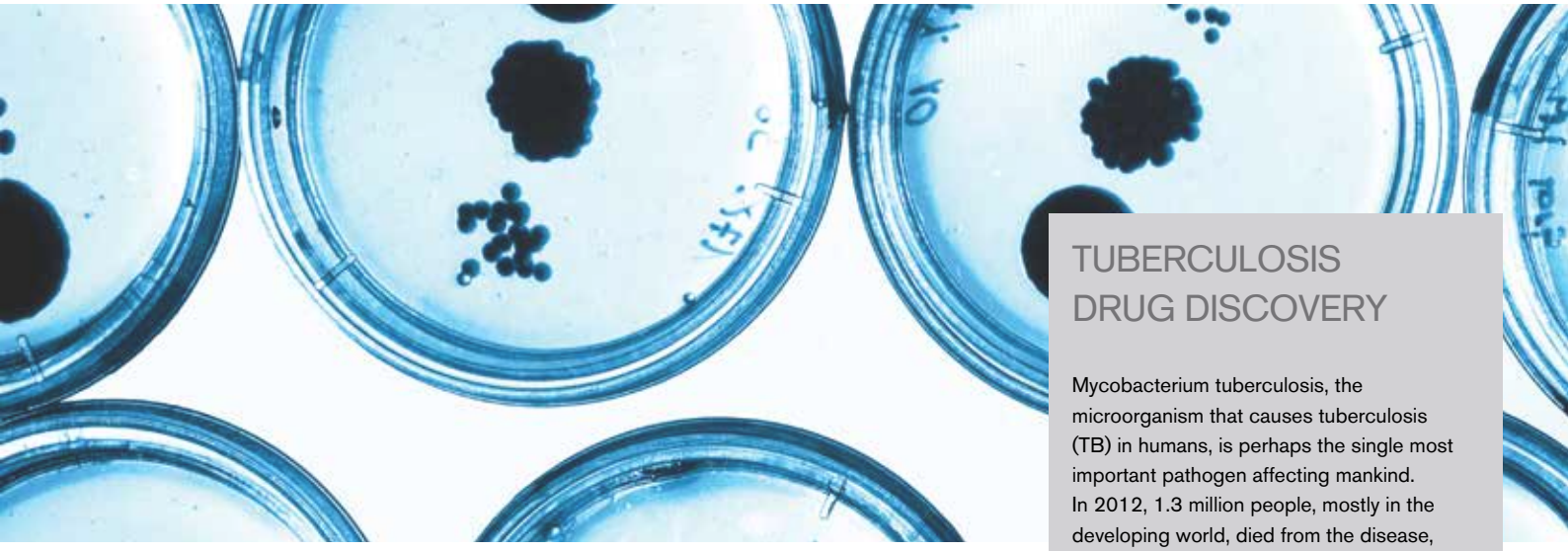
College of Engineering and Physical Sciences Research

CHEMICAL BIOLOGY AND DRUG DISCOVERY

Our researchers are exploiting the power of catalysis and synthesis to generate new molecules and materials which allows us to probe the function and behaviour of biological systems, source new drug molecules and generate drug delivery systems. Our focus encompasses synthetic chemistry of small molecules and complexes through to synthetic biology involving modified peptides and nucleic acids, as well as methodology for the total synthesis of entire proteins.

Our innovative and wide-reaching research work includes the computer-aided design and subsequent synthesis of potential pharmaceutical compounds for probing their reactivity and biological behaviour. We also develop new routes for the stereoselective synthesis of small molecules and identify new catalysts for the synthesis and development of biomimetic molecules. The metal complexes we make, as well as our modified peptides and nucleic acids, can be used to mimic or probe various biological processes.

With a large, well-established and vibrant research base in life sciences and medicine at Birmingham, the possibility for translating fundamental chemistry into therapeutic application is very real. We are currently targeting diseases such as various cancers, tuberculosis and irritable bowel syndrome, along with infection, resistance to antibiotics and vaccine development.



INDUSTRIAL COLLABORATIONS AND OPPORTUNITIES

This area of research creates links and partnerships with biosciences, pharmacy and medicine, as well as to local doctoral training programmes at Birmingham, such as the Midlands Integrative Biosciences Training Partnership (MIBTP) and the Centre for Doctoral Training in Physical Sciences for (Sci-Phy-4-Health). Our research portfolio has been supported by major pharmaceutical companies, including AZ and GSK.

The pharmaceutical industry remains a key employer of UK chemistry graduates. This area of research benefits from recent changes in strategy and working practices in the global pharmaceutical sector, leading to more outsourcing, the partnering of academic multidisciplinary teams in outreach projects, and pre-competitive research. Many of our students spend a year on an industrial placement – and we are encouraging even more to do so, as the benefits to both student and industry are great.

TUBERCULOSIS DRUG DISCOVERY

Mycobacterium tuberculosis, the microorganism that causes tuberculosis (TB) in humans, is perhaps the single most important pathogen affecting mankind. In 2012, 1.3 million people, mostly in the developing world, died from the disease, which is now resurfacing in wealthy countries including the UK. So finding new antibiotics to help cure TB is, therefore, one of the most pressing and exciting challenges in life sciences today.

TB is curable, although the current treatment involves taking a cocktail of drugs for at least six months. New compounds – selected specifically for their ability to overcome the growing list of Mycobacterium TB strains that are resistant to established drugs – are beginning to generate a small pipeline of potential future therapies, but the development of effective drugs for treating TB remains a formidable challenge.

In a fruitful collaboration with biosciences researchers and scientists from our industrial partner, GSK, we are looking to turn 'hits' (initial compounds that possess anti-TB activity) that we identified from a large-scale screening programme into 'leads' (compounds with drug-like properties).

After identifying initial hits, we take these small drug-like hit molecules that we know kill Mycobacterium TB and use a wide range of molecular, biological, and genetics techniques to identify the mycobacterial proteins these hits act upon. Having found our drug target, we undertake mode-of-action studies to understand how it works. Organic synthesis and medicinal chemistry now come into play as we seek to modify the structure of the hit in order to impart more favourable drug-like properties on the molecule, wherever possible guided by structural biology and in silico modelling methods, which help us to analyse the interactions between the protein target and the inhibitor. Our long-term goal is to transform these initial hits into lead molecules for future drug candidate selection.

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.

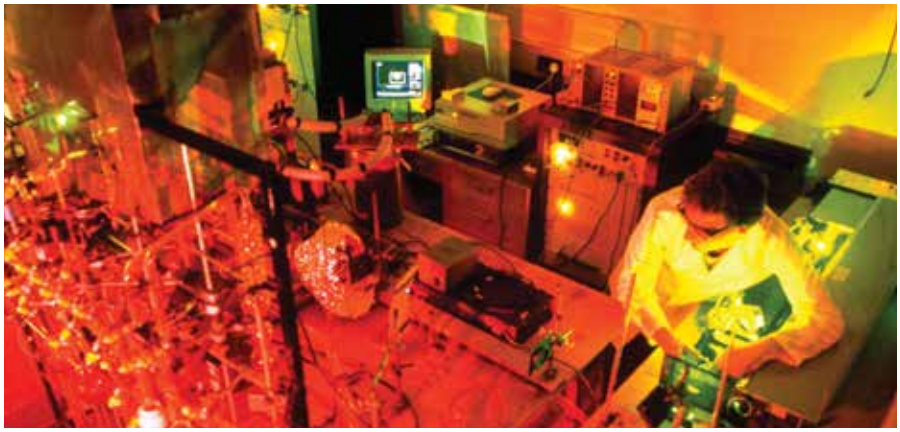
The X-ray diffraction facility is equipped with state-of-the-art diffractometers offering both single crystal, powder X-ray diffraction and X-ray fluoresce analysis. Our instruments enable rapid data collection and structure determination over a wide range of temperatures.

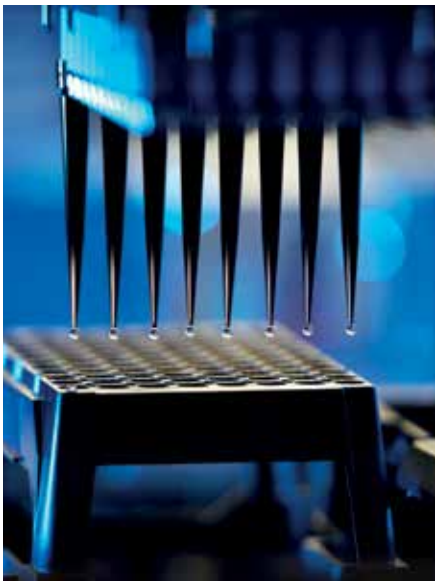
The mass spectrometry laboratory offers an extensive range of techniques and ionisation methods that include: electron ionisation (EI), chemical ionisation (CI) and GC/MS, LCMS, electrospray (ES)/APCI, accurate mass measurement, liquid secondary ionisation mass spectrometry (LSIMS) and matrix assisted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

As part of our extensive capabilities in synthetic chemistry, we can also undertake peptide and oligonucleotide synthesis as part of collaborative research projects with industry and other external users.





Learn more

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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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