10 YEARS
2006–2016

MIB

Discovery through innovation
Manchester Institute of Biotechnology

The Manchester Institute of Biotechnology is committed to the pursuit of research excellence, education, knowledge transfer and discovery through innovation whereby a coherent and integrated interdisciplinary research community work towards developing new biotechnologies that will find applications in areas such as human health, the energy economy, food security and the environment.
Research is at the heart of The University of Manchester and the sheer scale, diversity and quality of our research activity sets us apart. Much of this research combines expertise from across disciplines, making the most of the opportunities that our size and breadth of expertise affords. We’re able to combine disciplines and capabilities to meet both the challenges of leading-edge research and the external demands of government, business and communities.

The Manchester Institute of Biotechnology (MIB) was established in 2006. Based at the John Garside Building, the Institute operates at the interface between biology and the physical sciences, engineering, mathematics and computation, consolidating scientists and engineers from the Faculties of Science and Engineering (FSE) and Biology, Medicine and Health (FBMH).

**Working across boundaries - pluralistic, integrative and non-exclusive**

The diversity of expertise we have assembled, supported by excellent infrastructure, provides a structure in which challenge-oriented bioscience is pursued. Strategic research challenges are built on genuine research strength realised through the assembly of unique multi-investigator research teams.

Our scientists and engineers are using advanced quantitative methods to explore the relationship between the macro behaviour of biological systems and the properties of their nanoscale components. We are strongly placed to translate this knowledge toward biotechnological application in a wide range of industrial sectors including chemicals, pharmaceuticals and energy, whilst increasing our fundamental knowledge of biosciences.

An extensive programme of technology and instrumentation development lies at the heart of our research programme embedded within state-of-the-art research facilities and supported by internationally renowned Centres of Excellence. This allows us to continuously accelerate progress through the provision of experimental platforms, measurement expertise, and data interpretation for quantitative bioscience.

Our overall approach is pluralistic, integrative and non-exclusive.

Nigel Scrutton
Director, Manchester Institute of Biotechnology (2010–present)
Discovery through Innovation Pipeline

The Manchester Institute of Biotechnology is committed to the pursuit of research excellence, education, knowledge transfer and discovery through innovation whereby a coherent and integrated interdisciplinary research community work towards developing new biotechnologies that will find applications in areas such as human health, the energy economy, food security and the environment.
The diversity of biotechnological application is immeasurable. It is helping us to develop innovative products and processes that can help us to feed, fuel and heal the world.

Our Research

Fossil fuels have been the primary source of energy for society since the Industrial Revolution, a limited, non-renewable and polluting resource. They provide the raw material for the manufacture of many everyday products that we take for granted including pharmaceuticals, personal care products, plastics and fuels. The combined effect of fossil carbon depletion and climate change means we must find cleaner, more sustainable forms of energy.
What is biotechnology?

Biotechnology is any technological application that uses biological systems, living organisms or derivatives thereof, to make or modify products or processes for specific use (UN Convention on Biological Diversity, Article 2).

Biotechnology harnesses cellular and biomolecular processes to develop technologies and products that help improve our lives and the health of our planet.

We have used the biological processes of microorganisms for more than 6,000 years to make useful food products, such as bread and cheese, and to preserve dairy products.

The diversity of biotechnological application is immeasurable; it contributes to a range of sectors including medicine, agriculture and industry providing breakthrough products and technologies to enhance our everyday lives and improve our planet.

There is no industry better positioned to respond to society’s grand challenges as we tackle an ever increasing and ageing population, affordable healthcare, resource efficiency, food security, energy shortages and climate change.
**INDUSTRIAL biotechnology** uses living cells such as bacteria, yeast, algae or components of cells like enzymes, to make or modify products and processes for use in a wide range of industrial sectors including chemicals, pharmaceuticals, materials and energy.

From beauty products to life-saving medicines, many of the products we consume are manufactured on an industrial scale. The production of the chemicals, pharmaceuticals, food and energy we rely upon can damage the environment, producing waste, draining non-renewable resources such as petroleum and creating greenhouse gas emissions.

Industrial biotechnology allows us to use microorganisms and enzymes to make bio-based products that perform better, are more easily recyclable and derived from renewable resources. It’s revolutionising manufacturing processes so that products are economically viable, environmentally compatible and socially responsible.

A multidisciplinary approach is absolutely essential if we are to transform the traditional chemical and chemical-related sector to a sustainable and competitive one which draws on disciplines such as organic and synthetic chemistry, biochemistry, molecular biology, enzyme kinetics, genomics, proteomics, and bioinformatics and bioprocessing.

The MIB houses expertise across all these key areas and our world-leading capabilities in chemicals synthesis and manufacture is enabling us to develop bio-based products and processes that perform better, are more easily recyclable and derived from renewable resources.

We are developing chemical alternatives to finite materials used as catalysts in the manufacture of many high-value products. A collaboration with BASF, has led to the efficient and environmentally friendly production of organic chemical compounds used to make active pharmaceutical ingredients and fine chemicals to support industrial and academic drug discovery programmes.

In collaboration with industrial partner DSM we have redesigned an enzyme catalyst, enabling it to convert a natural product into the cholesterol-lowering drug pravastatin in a single step. This streamlined method now forms the basis of a patented process for the production of this drug. By cutting the cost of pharmaceutical production, industrial biotechnology is also helping us to address global inequalities in places where access to modern, expensive treatments is a major issue.

**ENERGY biotechnology** utilises biotechnological processes to produce bioenergy and represents the single largest renewable energy source today. Research includes utilising biomass from agricultural sources to the development of novel biocatalysts to advance the production of biofuels, chemicals and other bioproducts.

The vast majority of energy is currently derived from fossils fuels. During the next two decades the chemical industry will undergo a major transformation. As both oil and natural gas begin to deplete, there will be a growing need to switch from oil-based starting materials to those derived from biomass.

Biotechnology-based processes will need to be developed to efficiently convert inexpensive raw materials to high-value products such as pharmaceutical drugs, cosmetics and fuels. Our contribution to this agenda focuses in particular on the biological aspects of energy including fuel cells, solar energy, and biofuels.

Our expertise is bringing commercial production of biofuels one step closer. In collaboration with Imperial College London and the University of Turku we made a significant breakthrough in the development and production of renewable propane, used in heating and transport. We’ve also formed a spinout, C3 Bio-Technologies Ltd, to bring bio-propane to the market more quickly. In a complementary project, we are working with Shell to provide a new, cleaner route to the production of alpha-olefins – crucial chemicals in a variety of industries.
HEALTHCARE biotechnology constitutes the leading segment of the whole biotechnological industry on an international level.

New discoveries in biotechnology are applied to medical processes that can find applications in areas such as pharmacogenomics and drug production. The development of modern medicines requires an understanding of molecules and networks at the molecular and systems levels which involves imaging and spatial mapping of cell responses in health and disease and in response to drug challenges.

Our expertise ranges from structural and dynamic modelling of potential drug targets and their interactions including establishment of early phase drug discovery pipelines through to the challenges of systems mapping of the “virtual human”.

Working with the Cancer Research UK Manchester Institute we have succeeded in purifying a protein found in bacteria that could reveal new drug targets for inherited breast and ovarian cancers as well as other cancers linked to DNA repair faults. We have also determined how an enzyme in the brain interacts with a drug-like lead compound for Huntington’s disease to inhibit its activity, demonstrating that is can be developed as an effective treatment for neurodegenerative diseases.

We are host to iFAAM (Integrated approaches to Food Allergen and Allergy Management), the world’s biggest ever study of food allergy which has led to the formation of spin-out ReactaBiotech Ltd. Another of our spin-out companies, Spectromics, is developing a diagnostic that can guide antibiotic treatment to help in the fight against growing levels of microbial resistance to antibiotics.
Enterprise and innovation have always been fundamental aspects of The University of Manchester’s culture, and a key factor in our ongoing success. Our academics generate new knowledge every day, creating a wealth of intellectual property (IP) that has real world applications and the potential to enhance society.

The MIB pursues and is engaged in challenging research projects that enable us to make significant advances in science and engineering to benefit industry and society. Through innovative research we can help you achieve your objectives and face future challenges with confidence. From providing business solutions to nurturing talent, we will work with you to build a strategy for success.

Whether you’re an international blue chip, an ambitious SME, or a charity with an eye for innovation, there are a number of ways for commercial business to benefit from the academic expertise fostered in the MIB. We run a successful programme of networking events with industrial partners and other stakeholders that focus on developing practical strategies to create short-term, mid-term and long-term relationships for mutual benefit.

Our partnerships include large pharmaceutical companies to SMEs from the chemical, biotechnology and biopharmaceutical sectors, regional/national entities, leading UK universities and the N8 Industry Innovation. These include GlaxoSmithKline (GSK), MedImmune, UCB, Synthace, Syngenta, Shell, Bruker, Solvay, Unilever, consortium members of CoEBio3 (AstraZeneca, BASF, Codexis, Dr Reddy’s, GSK, Lonza, Merck, Syngenta), and CHEM21 (GSK, Sanofi, Bayer, Janssen, Orion, Pfizer, ACIB, CatSci, Charnwood Consulting, Evolva Biotech and Reaxa) and many SMEs.

Benefits of collaborative research include:

- Delivering internationally recognised programmes across all disciplines, with a strong emphasis on translation, knowledge transfer and discovery through innovation.
- Advancing economic and societal development through knowledge generation and transfer.
- Exploiting commercially significant innovation through licensing and the creation of spin-out/spin-ins.
- Developing next generation interdisciplinary science leaders with a deep appreciation of, and ability to drive, state-of-the-art biotechnology research.

For further details of collaboration and partnership opportunities please contact

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For further details of collaboration and partnership opportunities please contact

- Commissioned, collaborative, sponsored and student research.
- Concept development, feasibility studies, secondments and partnerships.
- Consultant services, expert witness services and due diligence.
- Instrumentation-technologies development.
- Cost effective trialling and testing of products, drugs and compounds.
- Transfer of innovative techniques and practices from the laboratory to the manufacturing process.
- Direct licensing of innovative technologies and processes.
Networks in Industrial Biotechnology and Bioenergy (NIBB)

We lead four BBSRC/EPSRC funded industry-academia networks in Industrial Biotechnology and BioEnergy (NIBB). These national networks pool skills from academia and business to develop research projects and promote the translation of research into benefits for the UK.

“Improving the sustainability of our drug manufacturing processes through collaborations will not only reduce our industry’s carbon footprint but will also provide savings that can be reinvested in the development of new medicines, increased access to medicines through cost reduction and drive innovations that will simplify and transform our manufacturing paradigm”.

John Baldoni, Senior Vice-President for Platform and Technology Science, GlaxoSmithKline
Discovery through to commercialisation

We are committed to the successful translation of basic science into commercial success and our ‘Discovery through Innovation’ pipeline has supported 51 patents, 8 spin-out companies and more than 230 new invention disclosures and 11 licenses in the last 10 years (2006-2016).

Spin-out companies

**C4X Discovery Ltd** founded in 2008 by Dr. Andrew Almond and Dr. Charles Blundell is focused on the optimisation of drug discovery and design to create best-in-class drug candidates. C4X Discovery Ltd was valued at £31m when it floated on the London Stock Exchange in 2014.

**Bio-Shape Ltd** founded in 2015 by Prof. Perdita Barran, Dr. Claire Eyers, Prof. Sabine Flitsch and Dr. Hannah Roberts have developed a cutting edge technology based on mass spectrometry techniques which enables the analysis of biomolecules and their behaviours, in exquisite unprecedented detail.

**Discovery Biocatalysts Ltd** founded in 2011 by Prof. Nicholas Turner is a not-for-profit organization seeking to make enzymes generated in academia commercially available for companies to purchase and use.

**PharmaKure** founded in 2012 by Prof. Andrew Doig and Dr. Farid Khan is a drug discovery company focused on Alzheimer's disease exploring new uses for old drugs, offering great promise for the delivery of new therapeutic options to patient care. PharmaKure has patented its first drug, PK-048, for the treatment of Alzheimer’s disease.

**C3 Bio-Technologies Ltd** founded in 2015 by Prof. Nigel Scrutton and Mr. Michael Smith is utilising synthetic biology to develop an economically-sustainable manufacturing process for the full-scale production of bio-propane.

**PeptiGel Design** founded in 2013 by Prof. Aline Miller and Prof. Alberto Saiani is developing a family of self-assembling peptide based hydrogels that allow the creation of defined 3D microenvironments for cell culture applications.

**Reacta Biotech Ltd** founded in 2013 by Prof. Clare Mills and Prof. Ashley Woodcock is developing food challenge materials for the diagnosis of food allergies.

**Spectromics Ltd** founded in 2014 by Prof. Roy Goodacre is developing an innovative point-of-prescription test for bacterial infections that guides the treatment of antibiotics.

The University of Manchester Intellectual Property (UMIP) office is central to the University’s innovation strategy and acts as a bridge between industry and the Manchester academic community, managing and translating the technology from the laboratory to commercial application.
Our ‘Discovery through Innovation’ Pipeline has supported 51 patents, 8 spin-out companies and more than 230 new invention disclosures and 11 licenses 2006-2016
Science and Society

Science underpins our everyday lives and communicating what we do, why we are doing it and how new discoveries and innovation will impact on our lives is part of our social responsibility. A distinctive feature of the University is its commitment to this agenda aimed at enhancing the lives of all people, from local communities to international populations, through knowledge transfer and education.

Biotechnology research has the potential to impact enormously on industrial practice and wider society as a whole. Development and uptake of new technologies, however, requires an awareness and understanding of applied research by commercial and public stakeholders as well as encouragement, recruitment and training of the next generation of practitioners.

At the MIB we provide a programme that ranges from the design and delivery of open access teaching resources, to school visits and open days. We also provide hands on demonstrations of science in community engagement events and work closely with central social responsibility and widening participation teams to integrate our contributions into university-wide initiatives.

Outreach

We seek to provide key target groups with access to the scientific knowledge and rationale that underpins our research. We encourage our researchers and staff to use a variety of communication methods and platforms, making our science open to a variety of audiences.

Widening Participation

In the interests of promoting science to people of all backgrounds, our widening participation initiatives aim to enrich the experiences of children and young adults, particularly in the area of science education.

The MIB ties into the University’s central widening participation efforts aimed at inspiring the next generation of scientists, as well as providing information to those who influence the study and career choices of young people.

Student Engagement

Due to the subject-focused, department-based format of higher education in science, students can often be unaware of interdisciplinary research areas, such as biotechnology, or even discouraged from entering the field. At the MIB we aim to boost teaching across different subject areas and raise awareness of multidisciplinary approaches to addressing grand challenges through the creation of learning and training resources.

Public Engagement

The general public are the potential end-users of the outcomes of biotechnology initiatives undertaken at the MIB. Much of our research is also publicly funded by major national and international research councils. We seek to inform public understanding and gauge public perceptions as a path to public involvement in research outcomes at various events both within The University and externally.
We work closely with the University Public Engagement team, Manchester Museum and the Museum of Science and Industry to deliver events and activities including the Manchester Science Festival, National Science and Engineering Week and British Science Week. Highlights have also included: New Scientist Live, European Science Open Forum, ScienceX, Royal Society Summer Exhibition (‘The Complex Life of Sugars’) and workshops at the National STEM Teachers Conference.
The expertise we have assembled, supported by excellent infrastructure, provide a structure in which challenge-oriented bioscience is pursued. Strategic research challenges are built on genuine research strength realised through the assembly of unique multi-investigator research teams.

We are committed to developing highly employable postgraduates and future leaders with an ability to drive state-of-the-art biotechnology research. We endow our students and early career researchers with the key skills to enable them to work successfully across the disciplinary interfaces at the forefront of biotechnology, making them more employable as a result whilst strengthening the UK science base.

Students join a vibrant and dynamic international community of researchers and students from across the globe. In addition to the traditional UK doctoral training programmes we host a number of EU training networks. As a hub for EU and Industry funded programmes we have a strong track record in forging industry and stakeholder collaborations offering an unrivalled environment in postgraduate training that presents opportunities for placements in industry across a variety of research disciplines.

At postdoctoral level we have a strong emphasis on career development. It is important for our postdoctoral researchers to explore and develop individual career paths and we aim to create an environment in which researchers can excel and reach their full potential by offering them a full range of personal, professional and career development opportunities through The University’s Researcher Development Programme.

Training and Development

The MIB operates in the space between disciplines and faculties in a culture that transcends all boundaries and fosters a sense of community required to generate innovation at the interface. Our community work together synergistically to generate an overall output that is far greater than the sum of its parts.
MIB Fellowship Scheme

We actively promote career track research fellowships at the interface between engineering, the physical sciences and bioscience. Applications are encouraged from proactive individuals keen to participate in interdisciplinary research and interact in key societal and strategic research areas of interest to the MIB.

We offer an attractive fellowship extension scheme for fellows bringing in 4-5 years of external funding, whereby we will top up fellowships by 1 or 2 years additional support. We are confident in the quality of the fellows we wish to recruit and recognise the importance of stability at this career stage to enable our fellows to reach their full potential. Additional start-up monies may also be available depending on the nature and level of the externally funded research fellowship. These fellowships are seen as early stage entry into independent academic careers at Manchester. Throughout the 6-year period you will benefit from close manager and mentor support from senior colleagues in the MIB and will become a member of one of the University Faculties – Science and Engineering (FSE) or Biology, Medicine and Health (FBMH).

For further information on our fellowship scheme visit our web pages at www.mib.ac.uk.
Science works best in an environment in which no constraints are placed on intellectual curiosity, where new lines of investigation can be readily realised. The John Garside Building, home to the Manchester Institute of Biotechnology (MIB), provides the physical infrastructure, research environment and culture in which cutting-edge research at the interface to biology can flourish.

The vision for the MIB was entirely driven by a desire to provide a dedicated scientific infrastructure that would enable and revolutionise the way in which biosystems could be studied.

The MIB provides a unique environment enabling multidisciplinary teams to flourish, functioning flexibly as a partner to researchers across a broad spectrum of disciplines, accelerating the discovery of breakthrough technologies and informing new fields of study.

The Institute was designed by Anshen + Allen (acquired by Stantec in 2010) and developed with input from scientists across the University. With the support of the Wellcome Trust and the Wolfson Foundation, construction began in 2003 and was completed in early 2006. The 13,100m² state-of-the-art research and support space features open-plan, multifunctional research laboratories and extensive specialist facilities over five floors.

The architecture of the MIB reflects the needs of interdisciplinary science and encourages purposeful and serendipitous encounters between researchers across different discipline backgrounds. The atrium at the centre of the Institute provides networking space and walkways and informal meeting areas crisscross the main atrium connecting the laboratories with the support space.

Materials inspired by Manchester’s important civic buildings were used to inform the choice of materials used with offices clad in limestone while copper was used to clad the laboratory wings. The MIB quickly won critical approval, picking up local, national and international awards. It represented the new face of research in the UK and an electrophoretic DNA fenestration pattern proudly identifies the MIB as a building of science.
Culture, communication and commitment

The Manchester Institute of Biotechnology provides the academic space to promote conversation and the serendipity which generates good collaborations.
Centres of Excellence

The MIB is an engine room for driving innovative research with exceptionally strong foundational sciences served by pioneering Centre’s of Excellence.

**National Centre for Text Mining (NaCTeM)**

NaCTeM, established in 2004, is the first and largest publicly-funded text mining centre in the world. The Centre applies innovations in text mining to large-scale bioscience and biomedical resources, developing automated methods for information retrieval.

[www.nactem.ac.uk](http://www.nactem.ac.uk)

**Manchester Centre for Integrative Systems Biology (MCiSB)**

MCiSB, established in 2006, provides a hub for cutting-edge systems biology research pioneering the development of new experimental and computational technologies and skills necessary for the development of quantitative Systems Biology, and its exploitation. [www.mcisb.org](http://www.mcisb.org)

**Centre of Excellence for Biocatalysis, Biotransformations and Biocatalytic Manufacture (CoEBio3)**

CoEBio3, established in 2005, is one of the leading biocatalysis organisations in the world. The multi-centre consortium allows CoEBio3 researchers to undertake fundamental and applied research in industrial biotechnology to create new biocatalyst-based processes to meet the changing needs of industry in the next 10-20 years. CoEBio3 will train graduate and postdoctoral scientists such that they possess the necessary combination of skills in chemistry, biology and engineering needed to support these changes.

[www.coebio3.manchester.org](http://www.coebio3.manchester.org)
Michael Barber Centre for Collaborative Mass Spectrometry (MBCCMS)

MBCCMS provides an enhanced understanding of the analytical techniques that underpin proteomics, metabolomics and the investigation of other molecules of biological significance. New developments in quantitative mass spectrometry provide much needed information for modelling of biological networks, while techniques are being developed for the analysis and quantification of a variety of post-translational modifications.

www.mbc.manchester.ac.uk

Waters Corporation’s relationship with the University in this field goes back over 40 years. This bond was strengthened in 2012 with the creation of the Waters Chair of Mass Spectrometry. Professor Perdita Barran was later appointed to this post alongside the role of Director of the Michael Barber Centre for Collaborative Mass Spectrometry (MBCCMS).

A good proportion of the Waters Corporation research and development people are former students of the University and Waters are a major local employer in high-tech science instrumentation.

“Our work with the University has led to global impacts in the use of mass spectrometry for pharmaceutical development, food and beverage safety, forensics, environmental monitoring, sports doping and even locally into routine diagnostic use in Manchester’s hospitals. We share the University’s goals of being a leader in scientific research and technology innovation”.

Brian Smith, Vice President of Mass Spectrometry Business Operations at Waters Corporation

Manchester Centre for Biophysics and Catalysis (MCBC)

MCBC, established in 2009, is a state-of-the-art cross disciplinary platform technology centre integrating biophysical, structural, and computational methods to address contemporary problems in catalysis and the dynamical properties of biological macromolecules. By going beyond simple structure determination of biological molecules MCBC is driving the new ‘dynamics determines function’ paradigm through temporal analysis of dynamic transitions relevant to biological function and catalysis from the femtosecond to second timescale.

www.mcbc.manchester.ac.uk
Centre of Excellence in Biopharmaceuticals (COEBP)

COEBP, established in 2011, is an interdisciplinary research centre initiated by support from the European Regional Development Fund and the North West Regional Development Agency. The Centre brings internationally recognised expertise together to accelerate the development and certainty in the production, harvest and utilisation of biopharmaceuticals.

www.coebp.manchester.ac.uk

Manchester Synthetic Biology Research Centre for Fine and Speciality Chemicals (SYNBIOCHEM)

SYNBIOCHEM, formed in 2014, is a UK/European Centre of Excellence funded by BBSRC/EPSRC. The Centre aims to develop new faster, more predictable and reliable “greener” routes to fine and speciality chemicals production. The Centre will provide tools, technology platforms and synthetic biology ‘know-how’ to drive academic discovery and translate new knowledge and processes towards industrial exploitation. The technology will lead to new products and methods for drug development, such as new antibiotics, and agricultural chemicals and new materials for sustainable manufacturing.

The Centre has developed a series of unique and highly integrated interdisciplinary technology platforms and a truly world-leading physical infrastructure for contemporary fine and speciality chemicals production. Our multiple science programs will deliver bespoke SynBio solutions for chemicals synthesis by adopting modular “plug and play” platform approaches and a production pipeline that embraces the “design-build-test-deploy” life-cycle.

The emerging societal, ethical, and regulatory challenges (Responsible Research and Innovation, RRI) associated with this rapidly advancing new technology are addressed in close interaction with social scientists and economists across The University of Manchester and involve a variety of stakeholders and the public to consider the potential future benefits and risks of our research.
Solutions for 21st century industry

As the 21st century progresses and we move towards more bio-based economies, we need solutions for the manufacture of chemicals that are smarter, more predictable and more sustainable.

Industrial biotechnology, combined with the emerging science of synthetic biology, has the capacity to transform the UK and European industrial landscape and revolutionise manufacturing processes.
Research Facilities

We have an impressive range of specialist research facilities maintained by dedicated experimental officers offering flexible and tailored use of our facilities ranging from walk-in service to formal collaborations. Services and equipment are available to University of Manchester researchers and external stakeholders from academia and industry.

Protein Science – an integrated approach

The Protein Science Facility at the MIB provides protein production services and access to the state-of-the-art instrumentation for the analyses of protein structure, dynamics and function. Supported by a suite of anaerobic facilities all experiments can be carried out in O₂-free environment.

Manchester Protein Structure Facility
Enquiries: Dr. Colin Levy
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Tel: +44 (0)161 275 5090

X-Ray crystallography utilises X-ray diffraction by single protein crystals to elucidate three dimensional structures at atomic resolution. The technique plays a pivotal role in understanding how individual amino acids interact with small molecule ligands and cofactors.

The Facility provides a complete service pipeline, taking you from purified protein to crystal structure. Three Mosquito nanolitre pipetting robots combined with a TTP Dragonfly facilitate both primary screening and rapid optimisation of crystal trials. Targeted screening, matrix seeding and grid-based approaches are combined to provide an efficient platform for macromolecular crystallogenesis. Once crystals have been obtained, the facility benefits from regular access to Diamond Light Source.

Manchester Protein Expression Facility
Enquiries: Dr. Eddie McKenzie
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Tel: +44 (0)61 306 4170

The Facility provides a comprehensive resource for the high level expression and scale-up production of recombinant proteins. Currently we offer a choice of four expression systems: bacteria, pichia, insect and mammalian cells. Depending on particular needs we are able to provide either small scale production facilities for biochemical analysis and antibody production or larger scale production for structural studies. Equipment includes ÄKTAxpress Protein Purification systems; Biomek FXp liquid handling robot; Syngene chemiluminiscence imaging system and a 10 litre wavebag (GE Healthcare) for insect cell scale up.

The Facility collaborates extensively with colleagues from across The University and St Mary’s Hospital and Cancer Research UK Manchester Institute. External collaborators include Abcam, Syngenta, Heptares and Astra Zeneca.
The Biophysics Facility is one of the largest, academic ‘Kinetics and Spectroscopy’ facilities for bioscience research in the world and consists of over £1.5 million of state-of-the-art instrumentation. We offer cutting-edge biophysical equipment, which can be used to study many different chemical and biological processes over a range of timescales and temperatures. The facility is actively involved in a wide range of research topics and has contributed to a number of publications in a broad range of high impact journals.

The facility has developed the use of advanced spectroscopic tools to study catalytic, binding, structural and dynamical processes in biological macromolecules including advanced fluorescence techniques; Circular Dichroism (CD) spectroscopy; electrochemical approaches to probe redox properties of biological molecules using potentiometry apparatus; Fourier Transform Infra-Red (FTIR) spectroscopy; advanced fluorescence measurements and Raman spectroscopy. In addition to the above we offer a number of kinetic instruments to study biological and chemical reactions on the fs – sec timescale, including a range of stopped flow and laser techniques.

The Computational Chemistry Facility simulates protein function and dynamics using computational methodologies including protein dynamics and conformational change (MD simulations); free energy calculations (umbrella sampling, metadynamics); ligand binding (docking, metadynamics) and catalytic mechanisms (QM & QM/MM calculations).

Address and Contact Information:

**Biophysics Facility**

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**Computational Chemistry Facility**

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Mass Spectrometry Facility
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Gas-phase ion chemistry research provides an enhanced understanding of the analytical techniques that underpin proteomics, metabolomics and the investigation of other molecules of biological significance. New developments in quantitative mass spectrometry provide much needed information for modelling of biological networks, while techniques are being developed for the analysis and quantification of a variety of post-translational modifications.

Secondary Ion Mass Spectrometry (SIMS)
Enquiries: Dr. Nick Lockyer
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Tel: +44(0)161 306 4479

Mass Spectrometry Imaging techniques (SIMS, DESI and MALDI) are being researched and applied to the molecular characterisation of complex chemical and biological systems, including advanced materials, single cells and biological tissue. The aims include technology and methodology developments to provide novel insights into the chemical and spatial organisation and function of (bio) chemical systems at the molecular level.

MassSpec@Manchester

Mass spectrometric research has a long and rich history at The University of Manchester. In this network we bring together the experience and expertise of these researchers under one umbrella.
Nuclear Magnetic Resonance (NMR) Facility
Enquiries: Dr. Matthew Cliff
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Tel: +44 (0)161 306 4229

Nuclear Magnetic Resonance (NMR) spectroscopy is one of the principal techniques used to obtain physical, chemical, electronic and structural information about molecules. It is a powerful technique that can provide atomic resolution information on the topology, dynamics and three-dimensional structure of molecules in solution and the solid state. The breadth and quality of information attainable from NMR measurements makes it unique among spectroscopic tools.

The NMR Facility housed within MIB is equipped with one each of 400 MHz, 500 MHz, 600 MHz, and 800 MHz NMR spectrometers. These offer a combination of high-field strength, Pure-Shift techniques and Non-Uniform sampling to allow resolution in extremely homogeneous molecules like oligosaccharides.

EPR Facility
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Electron Paramagnetic Resonance (EPR) spectroscopy is a powerful technique for studying molecules with unpaired electrons (i.e. radicals). EPR is particularly useful for the study of metallo-proteins, such as cytochromes and iron-sulfur proteins, and those enzymes with (quasi) stable radical intermediates such as flavoenzymes or photosynthetic complexes.

Our focus is the study of radical/metal-containing biomolecules such as cofactors, metallo-proteins and radical enzymes. The facility houses a Bruker ELEXSYS E580 spectrometer operating at X-band (~ 9.5 GHz) that is capable of performing both continuous wave (CW) and pulsed EPR measurements at temperatures ranging from ~ 5K to RT. Applications include: continuous-wave (CW) EPR; electron nuclear double resonance techniques (ENDOR); electron spin echo envelope modulation (ESEEM); electron-electron double resonance (ELDOR/PELDOR/DEER); ELDOR detected NMR (EDNMR); rapid-freeze quench with subsequent EPR characterization (CW or pulsed); optically-excited CW and time-resolved EPR.

The MIB EPR Facility offers a range of advanced CW and pulsed EPR experiments and can operate as either a service or as part of a longer-term collaboration. We work closely with the Molecular Magnetism group and the National EPR facility in the Photon Science Institute both based at The University of Manchester.
Huntington’s Disease (HD) is a neurological disease for which there is presently no known cure or effective treatment. HD causes gradual physical, emotional and cognitive deterioration, leading to total incapacitation and eventual death.

Working with colleagues at the University of Leicester and the University of Lisbon in Portugal, MIB researchers have identified the molecular structure of the enzyme kynurenine 3-monoxygenase (KMO), which is found in the human brain. The study details how KMO interacts with an exciting drug-like lead compound for Huntington’s disease to inhibit its activity, demonstrating that it can be developed as an effective treatment for HD and other neurodegenerative diseases.

**WHY MIB?**

The MIB hosts one of the leading enzymology groups in Europe addressing challenges at the chemistry-biology interface in fields such as enzymology, protein structure/dynamics and spectroscopy.

**Developing sustainable biological and chemical alternatives to finite materials**

Pharmaceutical manufacturing currently uses finite materials such as precious metals as catalysts in the manufacture of medicines.

CHEM21 brings together 6 pharmaceutical companies, 13 universities and 4 SMEs from across Europe in a €21.2 million project with the aim of developing sustainable biological and chemical alternatives to finite materials for use in the pharmaceutical industry. The introduction of biotechnology to the manufacturing processes for medicines will limit the drain on the world’s resources and have a lasting benefit on the environment.

**WHY MIB?**

MIB hosts CHEM21 which is Europe’s largest public-private partnership with pharmaceutical company GlaxoSmithKline. Improving the sustainability of our drug manufacturing processes will not only reduce the pharmaceutical industry’s carbon footprint, but will provide savings that can be reinvested in the development of new medicines, increase access to medicines through cost reduction and drive innovations that will simplify and transform the manufacturing paradigm.
Delivering next generation antibiotics

One of the major challenges in healthcare is the provision of new antimicrobial agents that can combat antibiotic-resistant pathogens (superbugs) which are widely recognised as a global threat.

In partnership with GlaxoSmithKline, MIB researchers are developing biosynthetic engineering approaches to enable the rapid structural diversification of a class of highly potent antibiotics (lipoglycopeptides) that will provide access to large numbers of variants with potentially improved antimicrobial activities. The bioengineering methodologies developed here will be used to engineer a wide range of derivatives for other promising classes of antibiotics with considerable clinical potential.

WHY MIB?

MIB and Manchester has wide ranging expertise in synthetic biology, biosynthetic pathway engineering, structural biology and allied disciplines built on major investments and international networks that have established a leading Synthetic Biology Research Centre (SYNBIOCHEM).

Greener fuels

Propane, a major component of liquefied petroleum gas, is the world’s third most widely used motor fuel, and provides heat and energy for an estimated 14 million homes annually. Reducing its environmental impact is crucial in tackling global climate change.

Researchers from MIB, in collaboration with Imperial College London and the University of Turku, have created a synthetic pathway for biosynthesis of propane gas. This cutting-edge process has the potential to revolutionise the production of bio-fuel, forgoing the environmental issues associated with extracting fuel from non-renewable sources and drastically reducing the transport costs and carbon emissions associated with production.

WHY MIB?

The MIB’s multidisciplinary approach to industrial biotechnology is essential to finding new ways of generating energy. MIB is able to draw on a diverse range of skill sets within the institute and through its international partnerships. Our work on bio-propane harnesses these interactions through partnerships in the UK and overseas and has led to the creation of the MIB spin out company C3 Bio-Technologies Ltd.
Producing inexpensive pharmaceuticals

Hepatitis C is a major global health problem affecting around 150 million people worldwide. Many infected people live in countries where access to modern expensive treatments is a major issue.

MIB researchers have helped develop a new class of drugs that are highly effective in tackling hepatitis C, completely removing the virus from most patients.

In collaboration with the Free University of Amsterdam, we devised an efficient synthesis of telaprevir that combines biocatalysis with multicomponent chemistry.

Efforts can now focus on making telaprevir – the leading medicine in this area – widely available and affordable.

**WHY MIB?**

The MIB CoEBio3 Centre of Excellence is home to world leading academic expertise in biocatalysis. CoEBio3 has a long history of working in partnership with the pharmaceuticals industry to meet contemporary challenges in pharmaceuticals research. MIB expertise in biocatalysis is also supported by fundamental understanding of enzyme biocatalysts in the internationally recognised Manchester Centre for Biophysics and Catalysis (MCBC) also based in the MIB.

Efficient production of pravastatin

Statins are a major breakthrough in healthcare: widely used drugs that decrease the risk of coronary heart disease and strokes by lowering cholesterol levels. To make them more widely available, we need to reduce production costs.

Industrial researchers at the company DSM and researchers from MIB have devised a single-step fermentative method for the industrial production of the active drug pravastatin, which previously involved a costly dual-step fermentation and biotransformation process. This new biotechnologically advanced method forms the basis of a patented process for efficient production of this blockbuster drug.

**WHY MIB?**

MIB is one of the leading industry-interfaced biotechnology research institutes in Europe. MIB scientists are committed to translating basic discovery science into commercial reality and recognise the need to engage early in the translational journey with industrial partners.
Transforming chemicals production through synthetic biology

Many flavours and fragrances are sourced from botanicals, of which some contain only minute levels of the target compound. Engineering bacterial strains that produce these compounds could significantly reduce the environmental impact of traditional chemical synthesis.

The Synthetic Biology Research Centre for Fine and Speciality Chemicals (SYNBIOCHEM) focuses early activity in three key chemical targets: alkaloids, flavonoids and terpenoids. These projects aim to accelerate the production and scale-up of these chemical targets which are key to a wide range of sectors.

Why MIB?

SYNBIOCHEM has had major scientific success that is being translated for commercial applications, as evidenced by 80 scientific peer reviewed paper/review publications (in Science, Nature, Cell), new patents (plus an industry sponsored patent with Shell) and new spinout company C3 Bio-Technologies Ltd.

Food allergy and food allergens

Food allergy affects 17 million people in Europe alone, and around 220–250 million people worldwide. Management of both food allergy, by patients and health practitioners, and allergens, by industry, is thwarted by lack of evidence to either prevent food allergy developing or protect those who are already allergic.

iFAAM (Integrated Approaches to Food Allergen and Allergy Risk Management) will produce a standardised management process for companies involved in food manufacturing. It is developing evidence-based approaches and tools for the management of allergens in food. The knowledge from intervention studies will be integrated into food allergy management plans and dietary advice.

Why MIB?

Researchers based in the MIB work with 38 partners including industrial stakeholders (Unilever and Eurofins), patient groups representing people at risk of severe allergic reactions from Germany, the UK and Ireland and a risk manager and assessor group including the UK Food Standards Agency. Our spinout company, ReactaBiotech, is taking the development of oral food challenges forward and placing it on a sustainable footing.
Next generation materials for defence applications

There is a pressing need to develop and deliver new technologies and processes for the rapid and sustainable manufacture of new materials such as wearable high performance, multi-functional, semi-natural fabrics and materials, and next generation polymer adhesives for use in both civilian and military applications.

The MIB has formed a strategic partnership with the UK Defence Science and Technology Laboratory (Dstl) in the area of advanced synthetic materials to enhance the UK’s defence capabilities. At Manchester we believe that synthetic biology will drive the next generation of materials discovery, production and manufacture. Our existing synbio chemicals production platforms will support the bio-based production of materials monomers for existing and next generation adhesives.

WHY MIB?

Manchester and the MIB has wide ranging expertise in synthetic biology, additive manufacturing, materials/polymer science and allied disciplines built on major investments and international networks that have established a leading Synthetic Biology Research Centre (SYN BIOCHEM), the National Sir Henry Royce Institute for Advanced Materials, the National Graphene Institute and the Graphene Engineering and Innovation Centre. The University also hosts the BP ICAM Centre for Advanced Materials.

Sustainable manufacture of essential medicines

Currently, derivatives of natural products, widely-used as antibiotics, agrochemicals and other valuable compounds, are manufactured using multi-step synthetic (chemical) transformations to produce a final optimised drug molecule.

We have developed a scalable, cleaner and more competitive single-step process for the manufacture of high value natural product derivatives, including antibiotics. Improved approaches to pathway engineering will enable the total biosynthesis of the target antibiotics, circumventing the need for additional transformations, which will reduce the environmental damage caused by typical chemical processes.

WHY MIB?

MIB has wide ranging expertise in natural products discovery and bioengineering and leads NPRONET, a BBSRC National Network in Industry Biotechnology and Bioenergy (NIBB). This project brings together four academic labs and industrial partners, with a vision to fundamentally change the way that semi-synthetic antibiotics are manufactured, leading to the total biosynthetic manufacture of a range of other products of commercial and societal importance.
New routes to biofuels

One of the main challenges our society faces is the dwindling level of oil reserves which we not only depend upon for transport fuels, but also plastics, lubricants and a wide range of petrochemicals.

MIB researchers have identified the exact mechanism and structure of two key enzymes isolated from yeast moulds that together provide a new, cleaner route to the production of hydrocarbons and provides the basis for the development of new applications in biofuel and commodity chemical production.

Industrial biotechnology and bioenergy networks

To translate ideas and discovery into business applications that can overcome our biggest challenges, we need effective dialogue and communication.

These networks help drive new ideas to harness the potential of biological resources for producing and processing materials, biopharmaceuticals, chemicals and energy.

WHY MIB?

This fundamental research builds on our expertise in enzyme systems and provides the basis for the development of new applications in biofuel and commodity chemical production. This research is part of a longstanding collaboration with Shell and provides new insights into the possibility of circumventing current industrial processes which are reliant on scarce natural resources. This research is part of a longstanding collaboration between Professor David Leys and Shell.

WHY MIB?

The MIB hosts four BBSRC national Networks in Industrial Biotechnology and Bioenergy (NIBB) that catalyse research interactions with industrial partners, promoting the translation of research into benefits for the UK.

IB Carb – Glycoscience tools for biotechnology and bioenergy
NPRONET – Natural products discovery and bioengineering network
BIOCATNET - Biocatalyst discovery, development and scale-up
BioProNET – Network in bioprocessing
The University of Manchester is at the forefront of the search for solutions to some of the world’s most pressing problems, seeking to be a global force for positive change.

Research beacons at The University of Manchester

The University of Manchester’s research beacons are examples of pioneering discoveries, interdisciplinary collaboration and cross-sector partnerships that are tackling some of the biggest questions facing the planet.

These areas of investigation feature a unique concentration of high-quality research activity. They allow us to bring the best minds together to find new ways forward. The researchers in these fields are at the forefront of the search for innovative solutions to some of the world’s biggest challenges.

Addressing global inequalities

Advanced materials

Cancer

Energy

Industrial biotechnology
A bio-industrial revolution

Just as Manchester was at the heart of the first Industrial Revolution, The University of Manchester is now leading the way, both nationally and across Europe, towards a bio-industrial revolution. We’re at the forefront of a European industrial renaissance, creating next-generation chemicals for industrial and health care needs.

Industrial biotechnology and bio-based chemicals manufacture underpin one of the largest industrial sectors, forming the cornerstone of a €1.2-2 trillion European bio-economy responsible for 22 million jobs.

Combined with the emerging science of synthetic biology, industrial biotechnology has the capacity to transform the UK and European industrial landscape and revolutionise manufacturing processes.

The MIB has confirmed The University as a powerhouse of Industrial Biotechnology in Europe.