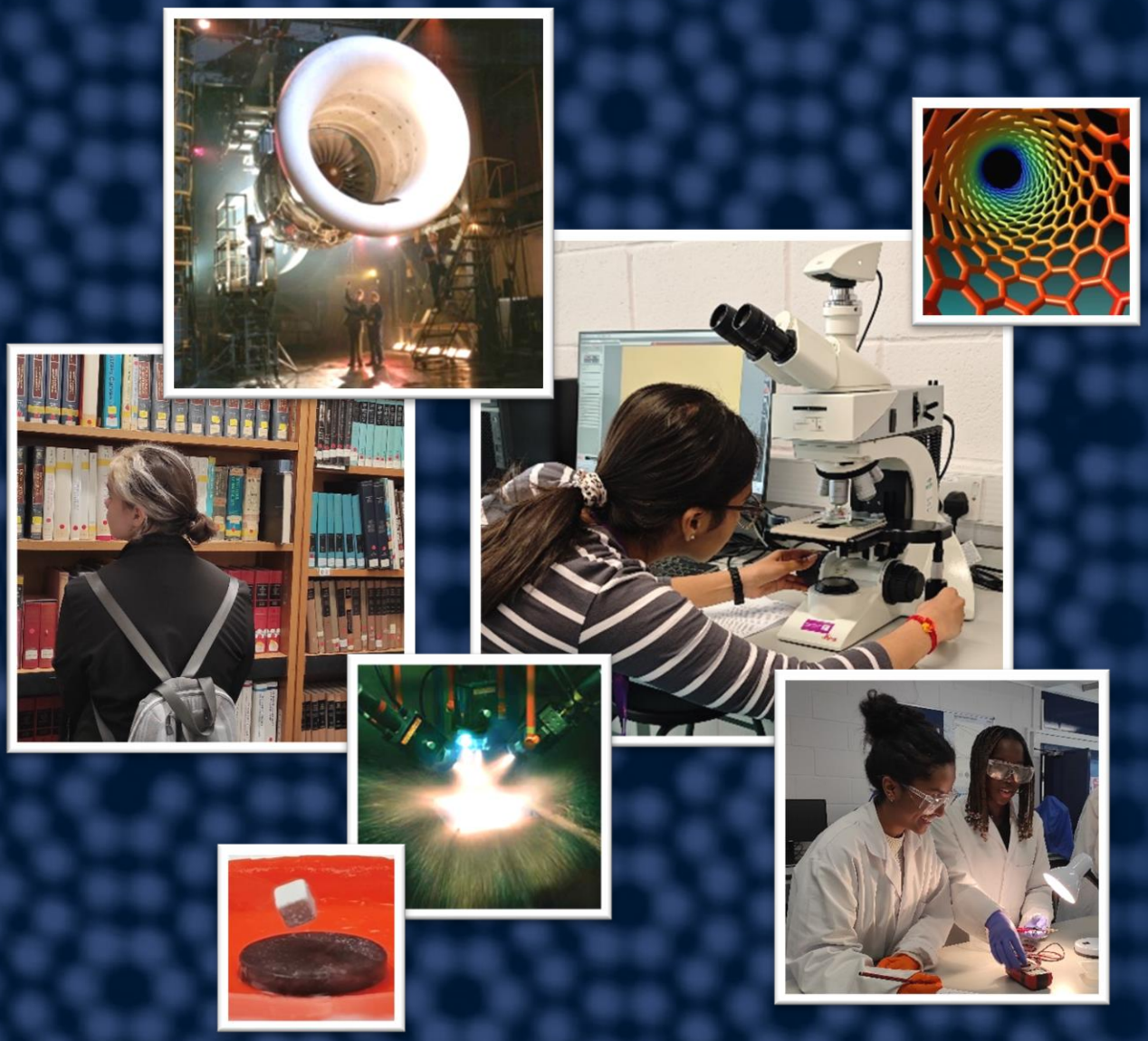
Materials Science

at Oxford University

MEng in Materials Science



UNIVERSITY OF OXFORD

DEPARTMENT OF MATERIALS

Materials Science at Oxford is an interdisciplinary subject that makes use of knowledge from Physics, Chemistry, Maths, Engineering, Biology & Medicine but which has its own special character. There are few areas of research and development that combine such a wide knowledge base and put it to such diverse practical and commercial use.

www.materials.ox.ac.uk

Materials Science (FJ22)

Revised January 2025

Simeon Ainsworth (St Edmund Hall, 2023)

I only found out about Materials Science just before applying, and over my first year of study I know I've chosen the best subject for me. I really enjoy being able to combine Physics and Chemistry to apply to a subject that feels like it's making an impact on the world around us. There's lots to do and specialise in, even though I don't know exactly what yet, but I have loved the Labs and learning about Defects and Microstructure in the first year. I'm excited for the next few years of study to learn more, find out more of what I love doing, and go on to apply it in real life.

Maddie Hawley (St Catherine's College, 2022)

My favourite topics at school were all part of what I now know as Materials Science, I just didn't have a word for it then. When I first saw the subject page online, I knew it was exactly what I wanted to study and have had my heart set on it ever since. I have loved my time at Oxford, learning more about the materials around me every day. My favourite parts of the course include the practical work, getting to use the microscopes and lab equipment, as well as the small group teaching, which are both invaluable and help you to truly understand the content.

Ariana Manduku (Mansfield College, 2021)

The entrepreneurship course in the second year was an excellent opportunity to explore how to transform scientific research into a viable business. It challenged me to develop a new skill in business plan writing and gave me a deeper understanding of the timeline from initial research to a market-ready product. The Team Design Project in the third year encouraged me to adopt a strategic, high-level perspective in problem solving, requiring me to consider a wide scope of factors. Working alongside a talented team of fellow Materials Scientists, we tackled a consulting-style case, developed a prototype solution, and presented our findings at the end. The Materials Science course at Oxford has been invaluable in cultivating a skill set that extends far beyond a purely scientific understanding.

What is Materials Science?

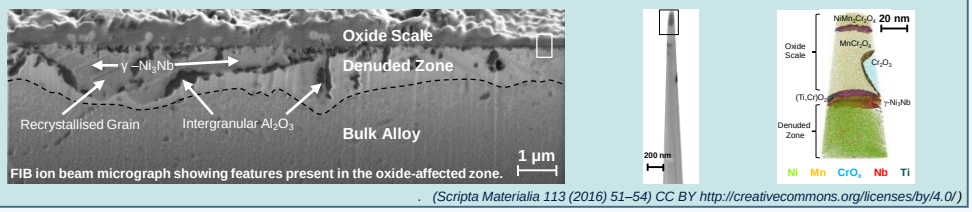
Materials Science (MS) is an interdisciplinary subject, spanning the physics and chemistry of matter, engineering applications and industrial manufacturing processes, but which has its own special character. Materials scientists study the relationships between the structure and the properties of a material and how it is made, they develop new or improved materials to meet engineering specifications, and they devise processes for manufacturing them. The subject encompasses the study of a wide range of materials including metals, alloys, composites, semiconductors, superconductors, ceramics, polymers, nanomaterials, and biomaterials.

Modern society is heavily dependent on the development and use of advanced materials such as lightweight composites and special alloys for transport applications, optical fibres for telecommunications, semiconductors and other materials for photovoltaic energy generation, materials and devices for energy storage, and silicon microchips for the information revolution.

Materials Science is critical to the practical realisation of our desire to generate power by nuclear fusion. It is at the core of nanotechnology, the production of machines and devices at molecular levels, which is likely to drive the next technological revolution. Such devices include those to enable quantum information processing; the key technology for a new generation of computers. There are also materials links with the medical sciences, for example through the development of bone replacement materials, tissue expanders, novel sensors and drug delivery systems.

The scope of Materials Science is truly vast, covering almost all areas of science. If you do not yet wish to be limited to a single science, are excited by the applications of science, and are looking for a fascinating degree subject and career then our materials programme could be for you.

Nickel-based superalloys are widely used in high-temperature environments, such as for gas turbine discs, but are subject to oxidation which can degrade their mechanical properties. A wide range of techniques such as Scanning Electron Microscopy, X-Ray Photoelectron Spectroscopy and Atom Probe Tomography are used to evaluate next-generation materials for improved oxidation resistance.



FIB ion beam micrograph showing features present in the oxide-affected zone.

(Scripta Materialia 113 (2016) 51–54) CC BY http://creativecommons.org/licenses/by/4.0/)

The MEng degree in Materials Science at Oxford

The programme covers the subject from its foundations in physics and chemistry to the mechanical, electrical, magnetic and optical properties of materials, and the design, manufacture and applications of metals, alloys, ceramics, polymers, composites, semiconductors and superconductors, nanomaterials and biomaterials.

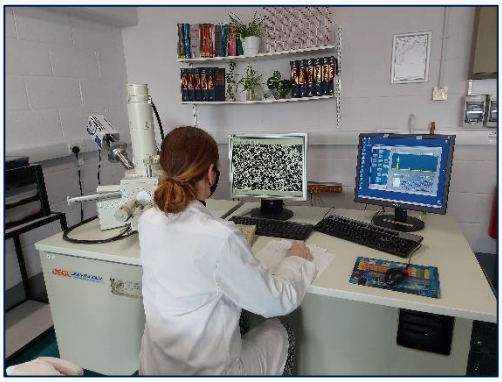
Practical work is an important part of the degree course and the Department has very good laboratory and teaching facilities, including a computer room and a well-stocked library. Students also have the opportunity to use a range of modern electron microscopes and other imaging devices.

The programme also offers an opportunity to develop an introductory understanding of entrepreneurship (learning how to write a business plan, raise capital and start a company). Students can gain industrial or research experience through a voluntary summer placement in industry or a university laboratory. Students develop teamwork skills through the entrepreneurship module and a team design project, and develop IT and presentation skills. There is an option to study a foreign language in the Language Centre or take a supplementary subject in another subject area such as History & Philosophy of Science. A series of lunchtime talks is given by scientists from industry and several industrial visits take place.

We also have a thriving student-led society, MatSoc, which organises additional trips to industry, talks by scientists and social events.

The Oxford Materials degree has the special feature of an eight-month research project in the fourth year, when students join the research teams of one of the strongest departments of Materials in the UK, or sometimes work in a prestigious overseas university or an industrial laboratory.

A wide range of assessment methods is employed in the award of the degree: 50% of the MS degree classification is determined by written examination papers; the remainder is allocated to practical work, assessed coursework and a thesis based on the fourth year research project.



Using a Scanning Electron Microscope to investigate crystal structures and fracture surfaces during laboratory sessions

Some course highlights

The first year at university is a major step for most people, with individual responsibility for your studies and a great deal of freedom in how you plan your time. A close working relationship with your tutor and others on your course can make reading for a degree a very different and highly rewarding experience.

The first year syllabus establishes the foundations of the subject of Materials Science. Students learn about the structure and properties of materials and are taught the mathematical techniques required for their further study.

Second year students develop stronger insights into their subject, are assisted and encouraged to study in greater depth and learn about entrepreneurship. Hard work has its rewards, especially when you start to feel that you can have a good, in-depth conversation with leading academics.

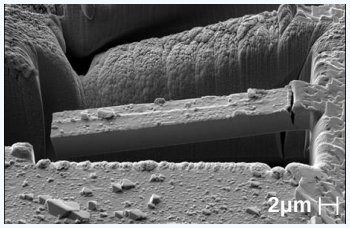
In the third year, the "Team Design Project" gives you a taste of research and development combined with costing and market research (as though you were trying to convince financial backers that your idea for a novel device/process etc. is worthy of their investment). Innovation and funding is always relevant in science for the 21st century. In the third year you also have some freedom to select your preferred lecture courses from a range of options.

In the fourth year, having completed their last written examination at the end of the third year, students have all three terms to concentrate on their own research project. This includes writing up a substantial thesis, giving a research talk and undergoing an oral examination.

There is no shortage of research topics in this leading research department and you are likely to be working on a significant project as a member of a world-class team. It is also possible to carry out the MS research project in an industrial laboratory or at an overseas university. Destinations have included MIT and Harvard.

Our students are encouraged to undertake a voluntary summer placement in industry or a research laboratory in order to gain experience of the application of materials science and also to hone their transferable skills. Past placements have been with Rolls Royce, Johnson Matthey, ATC Acoustic Engineers, Kahn Design, Novazure, and Breathe Battery Technologies, and at university laboratories in Oxford, Beijing, Shanghai, Zhejiang, Tokyo, Massachusetts, and Germany.

In some years a voluntary industrial tour to an overseas destination is organised in the Easter holidays. Previous tours have included: Beijing, Leipzig, Singapore, Provence, Sweden, Ontario, Krakow, San Francisco, Amsterdam, Milan, and Tokyo.



Photos from Practical Work and Visits

1. A visit to the Culham Centre for Fusion Energy as part of an outreach residential
2. FIB machined cantilever after test with Nanoindenter
3. The Great Wall of China
4. Structure of the roof of Bird's Nest Stadium, Beijing
5. Target Station at the ISIS facility, Oxfordshire

The Oxford M.Eng Degree in Materials Science for entrants up to and including October 2024 is accredited by the Institute of Materials, Minerals and Mining (IOM3), on behalf of the UK Engineering Council, towards the achievement of Chartered Engineer status. Normally this professional accreditation is reviewed on a five-yearly cycle and the next review is expected to take place in March 2025. Please see the Department website for the latest information on accreditation.

Year 1: Prelims

- Physical Foundations of Materials
- Structure and Mechanical Properties of Materials
- Transforming materials
- Mathematics for Materials Science

- Practical classes
- Crystallography classes
- Computing for Materials Science (MATLAB)

- Crystal Model Building
- Engineering drawing & CAD
- IT skills
- Industrial visits (optional)
- Career planning
- Foreign language (optional)
- Introduction to errors in measurement

Year 2: Part I

- Lifecycle, Processing & Engineering of Materials
- Electronic properties of Materials
- Mechanical Properties of Materials
- Structure and Thermodynamics of Materials

- Practical classes
- Industrial visits and talks

- Mathematics
- Communication skills

- Entrepreneurship module
- Foreign language (optional)
- Supplementary subject (optional)

Year 3: Part I

- Materials Options courses (examples of current options courses can be seen on the course website)
- Team design project
- Industrial visits
- Introduction to Materials Modelling module
- Characterisation of Materials/Atomistic Modelling module

(At the start of Year 3 it is possible to transfer to a 3-year BA (Hons) degree in Materials Science, graduating at the end of Year 3. A student opting to do this takes a smaller set of materials options lecture courses and carries out a literature-based research module. This option is intended for the occasional student who may change their mind about their career path while following our MEng programme. The BA(Hons) is not accredited)

Year 4: Part II

- Research project (full-time over 3 extended terms) includes training in project management, engineering ethics & sustainability, and information skills, with additional optional elements:

Presentation skills
Industrial visits
Careers events
Writing skills and Intellectual property rights (IPR)
Foreign language
Reference management
Workshop skills
LabVIEW

(Students are required to achieve 50% minimum in the Part I assessment in order to progress to Part II)

The course outline shown above is correct at the time of printing, but detailed content may change. Please see the Department website for an up-to-date summary of the current course content and advance notification of any planned changes.

Is Materials at Oxford for me?

The Department offers a blend of traditional and modern teaching techniques, with a high proportion of lectures given by staff who are judged by the UK Government's periodic assessment of research excellence in UK universities to be carrying out research which is either 'World Leading' or 'Internationally Excellent'. We are regularly judged as one of the overall best materials departments in the country (e.g. The Guardian League Tables and The Complete University Guide – University Rankings and League Tables 2025 (published in 2024)). Oxford's highly prized college-based tutorial system offers regular small group teaching, allowing tutors to deal with the specific needs of individual students, as well as encouraging stimulating and exciting discussion of the subject in an informal and friendly atmosphere. In addition to the tutorial teaching, the residential college system provides superb support, guidance and facilities during your time at Oxford. The Department of Materials teaches about 160-170 undergraduates over the four years of the course. This size gives a "family" feel to the department in which staff and students are often on first name terms. We also have an active and respected staff-student liaison committee (the JCCU) which inputs to the management of the Department. The MS degree provides the basis for developing highly competent, well-trained graduates. Whatever your ultimate destination, the key skills developed in numeracy, communication, analysis and in solving a wide array of problems, together with the high academic standards of the course, make Oxford Materials graduates highly sought after by industry, business and the financial sector.

Amelia Tortell Milhano
(St Anne's College, 2019)
Now: Materials Scientist, 4D Biomaterials

I chose to study Materials Science because of the wide range of subject matter it covers. When I started at Oxford I was interested in materials for renewable energy technologies. For my masters project I researched oxygen-redox battery materials. After graduating, I started working at 4D Biomaterials, a materials start-up that makes 3D printed biodegradable implantable medical devices. As a Materials Scientist, I mostly work on fine-tuning the manufacturing processes and determining final material properties through various mechanical and chemical tests. One of the benefits of working in a small early-stage company, is the opportunity to get involved in work outside of my specific job role. For example, getting involved in the regulatory aspects of developing new medical devices.

What tutors are looking for

The University of Oxford Department of Materials has high academic standards and seeks to maintain these standards by recruiting students of high calibre and potential. Decisions on admission are based on the individual merits of the candidate and the application of the selection criteria published on our website:

- Academic ability
- An interest in materials science topics
- Motivation and perseverance
- Independent working and communication
- Educational achievement

Performance in the **Physics Admissions Test (PAT)**, which all applicants take, will be considered along with all other factors in the selection process.

Entrance Requirements

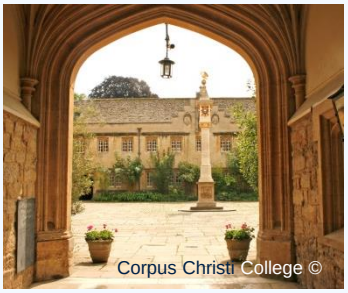
GCSE: Good grades overall, especially in maths and sciences and including Chemistry.

GCE (A-Levels): A*AA at A-level including Maths and Physics, with the A* in any one of Maths, Physics or Chemistry

SQA (Advanced Highers): AA or AAB including AA in Maths and Physics

IB (International Baccalaureate): 40 including core, with 766 at Higher Level including Maths and Physics, with the 7 at HL in any one of Maths, Physics or Chemistry

More information about these requirements and other equivalent qualifications can be found on the Department and the University websites.


Corpus Christi College ©


St Catherine's College © John Cairns

Colleges taking Materials Science undergraduates

Each college has its own character and traditions, and if you opt to specify a preference, you may like to take this into account. Also you might like to seek more practical information such as the typical number of materials students at the college or the extent and price of accommodation offered. Every college is a microcosm of the University, with students from most subject areas, sports facilities and teams, drama and musical societies etc. No matter what your skills and abilities, you will find a place in college for them. College will be your home during term time and many students maintain strong links with their college after they graduate.

At present seven colleges take Materials Science undergraduates. The number of students offered a place by each college may vary slightly from year to year.

Corpus Christi College	www.ccc.ox.ac.uk
Mansfield College	www.mansfield.ox.ac.uk
The Queen's College	www.queens.ox.ac.uk
St. Anne's College	www.st-annes.ox.ac.uk
St. Catherine's College	www.stcatz.ox.ac.uk
St. Edmund Hall	www.seh.ox.ac.uk
Trinity College	www.trinity.ox.ac.uk


Mansfield College ©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St Edmund Hall © John Cairns


The Queen's College ©

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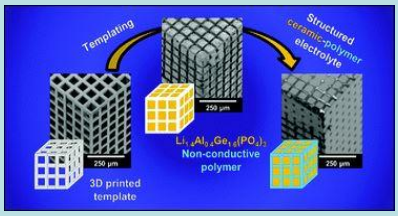
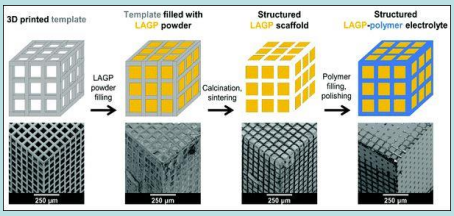
Career options for graduates

Our Graduates are highly sought-after by employers in many fields, not only those directly related to Materials Science and Engineering. Many apply their technical knowledge in the manufacturing industry, both in management and in research and development positions, and some train as teachers. Others enter the financial, IT, and consultancy sectors. A significant proportion of our graduates first undertake research degrees in universities in the UK and abroad, and some then pursue a career in the university sector.

Employment destinations at various career stages for our Materials Science graduates have included:

Software Developer	School Teacher
University Professor	Fusion Energy Researcher
Member of Parliament	Aerospace industry
Construction industry	Materials Engineer
Patent Attorney	European Space Agency
Consultancy firms	Science Fiction Author
Nuclear Engineer	Research administration
Investment Banker	Sustainability Engineer
Financial Analyst	Pharmaceutical industry
Electronics industry	Data Science
Energy Analyst	Polymer foams industry
Biomaterials industry	Metal trading & commerce





. *(Energy & Environmental Science 11 (2018) 185-201) CC BY http://creativecommons.org/licenses/by/4.0/)*

There are many challenges on the road to an all-solid-state battery with a lithium metal anode. One such challenge is identifying a solid electrolyte that has sufficient ionic conductivity without being too soft (polymer electrolytes) or too brittle (ceramics). This research developed a hybrid solid electrolyte, composed of 3D ordered bicontinuous ceramic and polymer microchannels, generated by 3D printing. The ceramic endows the hybrid with high ionic conductivity at room temperature due to continuous pathways for ions through the ceramic phase, whereas the polymer mitigates the brittleness of the ceramic, rendering the hybrid electrolyte more resilient to fracture.

Factors that make Oxford Materials graduates attractive to this wide range of employers include the following:

- The course is recognised to be intensive and challenging, so getting a good degree is a statement of your ability to work effectively
- You will be well trained in mathematics with expertise in analysis and solving problems
- Your IT and oral presentation skills have been developed and practised
- You will have an introductory grounding in entrepreneurial and business skills and experience of teamwork
- Proven ability to carry out and report on a substantial individual research project over eight months

These highly prized skills are additional to your first class grounding in Materials Science, taught by some of the world's leading practitioners in the field.

Not all companies require subject-specific education: they do require, however, numerate, articulate, skilled people with analytical minds. In addition to careers in the science-based industries and research institutions, as an Oxford Materials graduate you easily fit into:-

Administration	Accounting
Advertising	Publishing
Law	Journalism
Armed Services	Civil Service
Consultancy	Management
Education	Finance

Adrian Matthew (Corpus Christi College, 2012) Now: Business Development, Manufacturing R&D

My career started as a Materials Engineer on spacecraft, including the Rosalind Franklin Mars Rover. Then, I followed my hobby of cycling and moved to Brompton Bicycles. Now, I work to develop UK manufacturing capability at the Manufacturing Technology Centre. I use my materials background to regularly promote innovation, notably Laser Processing and Additive Manufacturing.

The 'Class of 2022' 1st Year Undergraduates. This image was taken during the 1st Year induction talks, which are typically held in the Department in one of our lecture theatres at the end of 'Freshers' Week'.

Anthony Akinwale (St Catherine's College, 2017) Now: DPhil at Oxford University

My highlight of the course was the Industrial Tour to Singapore where we saw the Materials Science content we were learning in lectures applied in various industries. A close second was completing my Master's project in the Atom Probe group as it was amazing to have the chance to spend a year dedicated to research using a multi-million pound piece of equipment to acquire novel results.

Charlotte Choi (St Anne's College, 2019) Now: Quantitative Research Analyst, JPMorganChase

My degree trained me as an analytical thinker, a rigorous and patient problem solver, and a flexible learner; these traits have proved invaluable in my career as a software developer in finance. Though I don't work directly with materials currently, I still feel connected to what I learned at Oxford through the entire world around me, from buildings to machines to electronics — materials are truly everywhere in our lives.

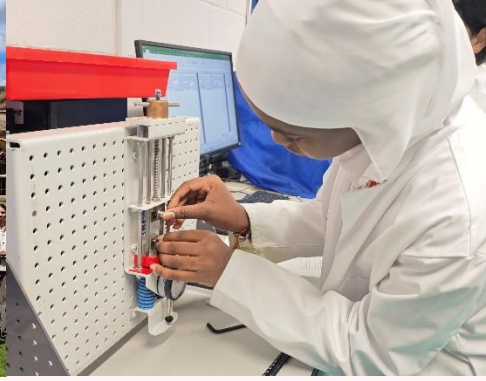
Laura Wheatley (Trinity College, 2015) Now: Associate Energy Analyst, International Atomic Energy Agency (UN)

One of the big benefits of Materials Science at Oxford is the small cohort size - each cohort supports one another academically and socially. Two opportunities I had during my studies were to organise an Industrial Tour to Beijing and become President of the Materials Science Society. Both my undergraduate degree, and my later DPhil in Materials Science, have given me a strong academic grounding, and my qualifications are highly regarded internationally.

Prof. Sarah Haigh (St Anne's College, 2000) Now: Professor of Materials Characterisation at Manchester Univ.

I am director of the Electron Microscopy Centre with 26 electron microscopes and over 450 users. My research interests centre on improving our understanding of nanomaterial properties by developing and applying advanced transmission electron microscopy (TEM) imaging and analysis techniques. I work closely with colleagues in the National Graphene Institute and have a particular interest is developing methods for atomic resolution imaging and analysis in liquids and gases.





Find out more

If you are interested in finding out more, there is further information available on the Department website: **www.materials.ox.ac.uk/admissions/undergraduate**

This includes :

- this brochure
- additional detail about the course we offer
- useful website addresses
- a suggested reading list
- detailed admissions criteria (middle QR code)

For more information on course, colleges, fees and funding, open days and applying to Oxford University, please look at the University of Oxford admissions website: **www.ox.ac.uk/study**

Pay us a visit

During February & March we host our own Departmental Open Days solely for the Materials Science Course, both in-person and online. These are the principal events for Materials Science in the year. In addition, there are three University Open Days, in June/July and September, that provide opportunities to visit more than one science department, including Materials, together with some colleges, all on one day.

Please note that booking is required to attend in February or March, but not in June/July or September.

Our Outreach Team also give talks around the country at schools and colleges. They also host a number of additional day and residential courses at the Department; see the department outreach website for details:

www.materials.ox.ac.uk/schools

Above images: 1) A problem solving workshop focusing on study skills useful for exams, interviews, and tutorials, 2) Students from the 2024 EDT Insight into University Residential Course holding their certificates in Mansfield College, 3) Students investigating the mechanical properties of different metals as part of the Y12 Materials & Physics day

Get in touch...

For further information on our course, please contact:

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T. 01865 273682

Other useful contact details:

Access & Outreach Manager, Dept of Materials
E. schools.liaison@materials.ox.ac.uk

Oxford University Undergraduate Admissions and Outreach
Wellington Square
Oxford OX1 2JD
W. www.ox.ac.uk/study
E. www.ox.ac.uk/ask

The main location of the Department of Materials on Parks Road, Oxford.

UNIVERSITY OF OXFORD

Cover Photographs:

Top left: The successful operation of Rolls-Royce aero engines relies upon many complex materials

Top right: An end-on view of the structure of a carbon nanotube

Middle left: A student in the Department library

Middle right: A student using an optical microscope

Bottom left: A magnet 'levitating' over a superconductor

Bottom centre: The process of electric arc spraying of molten steel onto a ceramic pattern

Bottom right: Students working on a practical experiment in our Teaching Labs

The background image is of a silicon crystal surface where each one of the bright spots is a silicon atom. The intricate atomic arrangement is called a surface reconstruction and crystal defects called vacancies can be seen where individual atoms are missing, These defects can give the crystal new properties. A member of one of the department's research groups captured this image using a scanning tunnelling microscope.