UNIVERSITY OF OXFORD

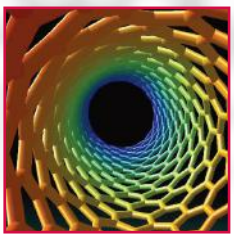
Materials Science at Oxford is an interdisciplinary subject that makes use of knowledge from Physics, Chemistry, Maths, Engineering, Biology & Medicine but which has its own special character. There are few areas of research and development that combine such a wide knowledge base and put it to such diverse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

Studying Materials Science

at Oxford University

MEng in Materials Science





OxfordMaterials

www.materials.ox.ac.uk

Materials Science (FJ22)

Revised June 2016

Rebecca Wang (Trinity College, 2014)

I found out about the course through looking online as it combines my favourite subjects at school. After attending a Headstart summer school, it confirmed that Materials Science was for me since it focuses on applying scientific theory to a broad range of real-life applications. The highlights so far include the opportunities to see Materials Science in action around the world. I have attended the departmental industrial tours to Canada and Sweden and I am lucky enough to take part in a 10 week research project at the Tokyo Institute of Technology. The college and tutorial system at Oxford means that teaching is highly individualised and the opportunities you get both within your degree and through student clubs and societies are second to none.

Sahasrajit Ramesh (St Anne's College, 2015)

I have always wanted to make a tangible impact on peoples' lives. Materials Science offers me the chance to continue my interest in how things behave on a very small scale, which I found most stimulating in my IB classes at school. I chose Oxford not only for its top class reputation, but because I was thrilled to see how social and friendly people were when I visited on an Open Day. One of the best things about studying here is learning the valuable skill of finding time to do fun stuff regardless of how much work you have.

Anna MacDonald (Trinity College, 2013)

I studied 4 A-levels; hard work but a great preparation for University study. Since commencing the course, research into biomaterials has fascinated me and I am interested in the opportunity to spend my final research year studying this at MIT in the USA. I have also become involved with a number of academic and social committees. If you maintain a sensible work-life balance you can certainly indulge the "work hard, play hard" ethos here at Oxford.

What is Materials Science?

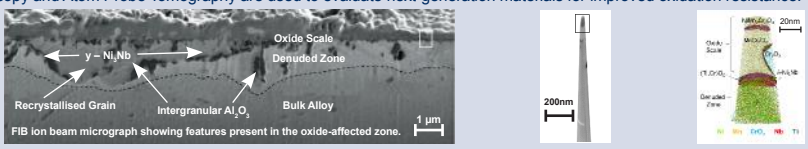
Materials Science (MS) is an interdisciplinary subject, spanning the physics and chemistry of matter, engineering applications and industrial manufacturing processes, but which has its own special character. Materials scientists study the relationships between the structure and the properties of a material 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, 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.

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, 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.

In a course taught partly by the Saïd Business School, 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.

Practical Class

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 Sydney, UCLA (Los Angeles), UCSB (Santa Barbara), Princeton and MIT.

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, The Low Carbon Research Institute, The Sports Technology Institute, Tata Steel, Johnson Matthey and Sharp Laboratories of Europe, and at university laboratories in Oxford, Beijing, Tokyo, California, Massachusetts, Poland and Germany.

A voluntary industrial tour to an overseas destination is organised in most Easter holidays. Previous tours have included: Ontario, Sweden, San Francisco, Amsterdam, Milan, Tokyo, Toulouse, Beijing and Munich.

➜ Photos from Industrial Visits and Tours

1. Investment Casting factory in Tianjin, China
2. The Great Wall of China
3. Yosemite National Park, USA
4. The Bullet Train to Kyoto, Japan
5. Target Station at the ISIS facility, Oxfordshire

The Oxford MEng Degree in Materials Science 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.

Year 1: Prelims	Year 2: Part I	Year 3: Part I	Year 4: Part II
• Structure of materials • Properties of materials • Transforming materials • Maths for Materials Science • Practical classes • Crystallography classes • Engineering drawing & CAD • IT skills • Industrial visits (optional) • Career planning • Foreign language (optional) • Introduction to errors in measurement	• Structure and transformation of materials • Electronic properties of materials • Mechanical properties • Engineering applications of materials • Practical classes • Industrial visits • Mathematics • Industrial talks • Communication skills • Entrepreneurship module • Foreign language (optional) • Supplementary subject (optional)	• Materials Options courses (examples of current Options courses can be seen on the course website) • Team design project • Industrial visits • Characterisation of Materials/ Materials 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)	• Research project (full-time over 3 extended terms) includes training in project management 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)

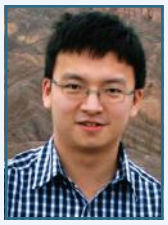
The course outline shown above is correct at the time of printing, but detailed content may change. Please see the Department website for an up-to-date summary of the current course content and advance notification of any planned changes.

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 gained one of the highest materials research ratings in the UK. We are regularly judged as one of the overall best materials departments in the country (e.g. The Guardian League Tables 2014 - 2017). 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 120 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.

Sarah Connolly (Mansfield College, 2010)
Now: DPhil at Oxford University
My UG admissions interview was nerve-racking, but everyone says they found it the same. The questions were based on my A-level knowledge but designed to apply this to new situations. Having graduated, I now look at processing of oxide dispersion strengthened steel for the nuclear industry in both fission and fusion applications.



Dr Evan Wang (St Catherine's College, 2006)
Now: Postdoc at Stanford University
I am currently interested in developing better technologies for understanding and controlling brain activities. The solid theoretical background and practical skills gained in my studies at Oxford prepared me well for my PhD here.

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 Aptitude Test, 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 A2 level including Maths and Physics, with the A* in any one of Maths, Physics or Chemistry

SCE (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 ©


Mansfield College ©

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


Trinity College ©


St Anne's College © Keith Barnes


St Edmund Hall ©


The Queen's College ©

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 for Materials Science graduates have included:

- Diplomat
- School Teacher
- University Lecturer
- Materials & corrosion engineer
- British Army Officer
- Aerospace industry
- Financial Institutions in the City of London
- Materials characterisation service
- European Space Agency
- University Researcher
- Patent Attorney
- Business and technology consulting firms
- Research administration
- Sustainability Engineer
- Nuclear Engineer
- Investment Banker
- IT Consultant
- Financial Analyst
- Strategy Analyst
- Electronics industry

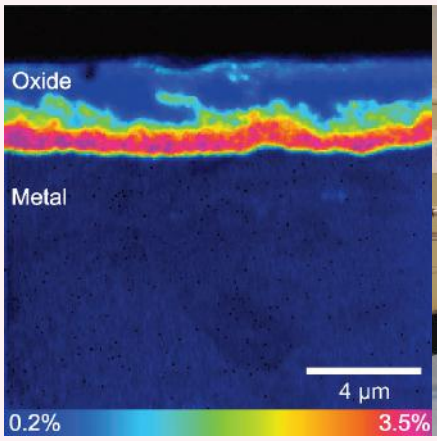
Factors that make Oxford Materials graduates attractive to this wide range of employers include the following:

- 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, 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



a) SIMS image of a zirconium sample that was oxidised in water containing ^{18}O allowing us to track the oxidation mechanism. The colour scale allows us to quantify how much ^{18}O has been incorporated. Where the image is dark blue the ratio of $^{18}O/^{16}O$ is 0.2%, the natural isotopic abundance. Where the image is orange/pink, this is where a lot of ^{18}O has been incorporated into the oxide, up to about 3.5%, i.e much higher than the natural isotopic abundance. This enriched region shows where ^{18}O from the water is reacting with the Zr metal. As it is at the metal/oxide interface it means that water can reach the metal surface directly and the oxide is not protective (it is porous).

b) The Cameca NanoSIMS 50 ultra high resolution chemical imaging instrument

Katherine Noon (St Anne's College, 2004)
Now: Manufacturing Engineer, Rolls-Royce

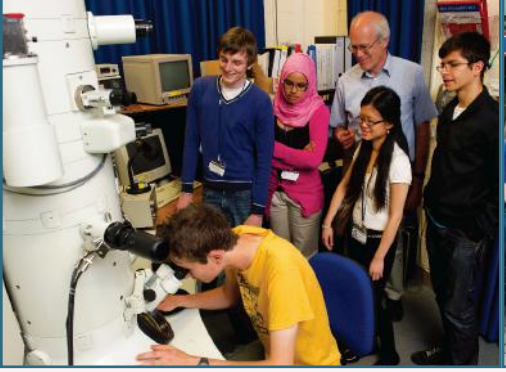
Materials Science was, for me, a wonderful combination of all the subjects I enjoyed. After graduation in 2008, I joined Rolls-Royce on their engineering graduate scheme. The 18-month scheme saw me working in Derby, Bristol and Canada. I then joined the manufacturing lab team, took over as the team leader for castings and now work as a manufacturing engineer. The daily challenge of ensuring high class manufacturing processes makes every day interesting, and Materials Science is still at the core of what I do.

Markus Mittermaier (Mansfield College, 2002)
Now: Director & Senior Equity Analyst, Sanford Bernstein

After reading for the MEng degree at Oxford, I joined the Venture Capital and Private Equity Group of Siemens. My Materials Science background was very helpful as I was able to join experts in assessing the technology during technical due diligence on a Materials-based investment. I joined the Harvard Business School class of 2011 for an MBA and am now a Senior Equity Analyst. I believe what will really stand the test of time are the problem solving skills and analytical thinking inculcated in us at Oxford. I am very grateful to the faculty for stretching our thinking beyond 'just understanding something'. It wasn't always comfortable - but, looking back, it was the best possible preparation for my career.

Dr Sarah Haigh (St Anne's College, 2000)
Now: Lecturer at Manchester University

As well as lecturing in Materials Characterisation, I carry out research studying the properties and uses of nanomaterials principally using transmission electron microscopy, (TEM). Since graduating I have been able to travel, teach and work all over the world and have really enjoyed it!



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** including :

- this brochure
- additional detail about the courses we offer
- useful web-site addresses
- a suggested reading list.
- admissions criteria **(http://www.materials.ox.ac.uk/admissions/undergraduate/admissions-criteria.html)**

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

Pay us a visit

During March we host our own Departmental Open Days solely for the Materials Science Course. 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 March, but not in June/July or September.

Our schools liaison staff give talks around the country at schools, colleges and Oxford and Cambridge student conferences. They also host a number of day and residential courses at the Department; see the schools liaison website for details. **www.materials.ox.ac.uk/schools**

Get in touch...

For further information on our courses, please contact:

The Schools Liaison Assistant
Dept. of Materials Science
Oxford University
Parks Road
Oxford OX1 3PH
E. undergraduate.admissions@materials.ox.ac.uk
T. 01865 273682

Other useful contact details:

Schools Liaison Officer, Dept of Materials
E. schools.liaison@materials.ox.ac.uk

Oxford University Undergraduate Admissions Office
Wellington Square Oxford OX1 2JD
W. www.ox.ac.uk/study
E. study@ox.ac.uk
T. 01865 288000

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Cover Photographs:

1) The process of electric arc spraying of molten steel onto a ceramic pattern
2) A student in the Department library
3) An end-on view of the structure of a carbon nanotube
4) A demonstrator advising students during a practical looking at corrosion effects on common metals
5) The successful operation of Rolls-Royce aero engines relies upon many complex materials

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.