MatSocMagazine

Winter2017/2018

IMPERIAL MATERIALS

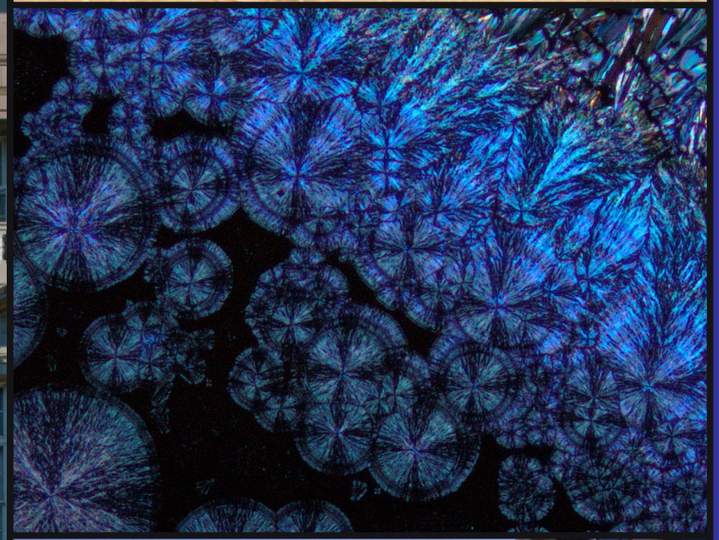
Est. 1851

The Materials Society (MatSoc) is a student run organisation which aims to enhance the experience of students studying in this department at Imperial College London, and to promote Materials Science and Engineering both at university and in industry. We achieve this goal through collaborative events, social functions, extra-curricular lecture series, and industrial visits to engage with Materials Science beyond an academic environment.

Our society currently has 695 members, including undergradate and postgraduate Materials Science students at Imperial, as well as other students studying other subjects who are interested in Materials Science and working in related areas upon graduation.

Image owned by Imperial College London

Photographer: Christian Richters



Contents

IMPERIAL MATERIALS Est. 1851

IMPERIAL MATERIALS Est. 1851

Welcome to the MatSoc Magazine:

Editors Foreword and Introduction

Amy Tall (Magazine Officer) and Harriet Frier (President) introduce this edition of the MatSoc Magazine. Gethin Banks, previous President, reflects on his time as part of MatSoc

Hello and welcome to the 2017/2018 Winter edition of the MatSoc Magazine! The production of this magazine is still a new project with the first issue being released in June 2017. Naturally, with a new editor comes a new structure and design, however, the fundamental aims remain the same. To quote my mission statement: "The MatSoc magazine is a publication designed to display and compliment the academic prowess and achievements of the Department of Materials (Imperial College London) while communicating the dynamic personalities of the people within". The amount of contributions and the vast range of topics which they cover is simply astonishing and I would personally like to thank all those that submitted articles. I hope you enjoy seeing your work formatted as a feature for print!

I hope this edition proves to be an enjoyable read and if you feel inspired to contribute to the Summer edition, please don't hesitate to contact me. Similarly, if you have any comments or ideas for features you would like to see, do inform me, or another member of the MatSoc committee.

Email: amy.tall16@imperial.ac.uk

Amy Tall

Magazine Officer

Hello everyone, I'm extremely excited to introduce the second edition of the MatSoc Magazine! I hope everyone finds it an interesting read; it's full of information and all things MatSoc! I am so proud to be the President of the society during such an exciting time. The magazine is a gateway for students to access information on careers or further study, and for students, staff and alumni to find out about what has been going on in the department. Students can use this magazine as a platform to explore their interests outside of core study, and engage with the department in their spare time. I really do encourage those who haven't submitted anything yet to do so for the next edition. Finally, I would like to personally thank everyone who has contributed so far, especially our wonderful Magazine Editor, Amy Tall, as you will see on turning the page that she has done an incredible job so far! I hope everyone has had an enjoyable term, and I look forward to the next.

Harriet Frier

MatSoc President (2017-2018)

The Last three years have taught me a lot about what it means to be a student at Imperial, and what it means to be part of the Department of Materials. When I joined, the department was a wholly different place, and I hope to communicate how the department, Materials community and MatSoc has changed. When I started at Imperial there were many things I loved about the department, however, I personally felt the greatest obstacle to students was a lack of cohesion within the department, between year groups, and most worryingly, within year groups. I felt that the problem had some major root causes. Having student's often living miles away from each other and the university really isn't ideal. This was compounded by the lack of a common space for students on campus to relax and discuss their work . Having said that, I must applaud the department for creating a common room this year, especially in a building where space is a commodity. Furthermore, there was a lack of Materials specific events that were offered to students throughout the academic year. I realised I was powerless to change these things, but I asked myself what I could do. The answer was trivial, get involved.

I was elected to take on the role of Publicity officer in my second year due to my desire to encourage students to get more involved with MatSoc. I pushed for this involvement so that we could forge a community that would eventually improve the environment for everyone within the department. This was naturally very easy as everyone at Imperial is highly enthusiastic! I must thank Simon Escobar (MatSoc President 2015-2016) for introducing the MatSoc Lecture series, which became a regular feature every two weeks, with free food and excellent content.

In my third year I was elected to be President. This was stressful, but rewarding none the less. Having been a member of the society in second year I found that the major factor that hampered the society's success was a lack of funds. When I became President, we started out with a meagre £800 which would need to be split across around 400 students for the entire year. For this reason I, alongside all other members of our committee, implemented a sponsorship drive which was very successful given that it was the first time our society had attempted to do something on this scale. Emails were sent to over 50 companies before the academic year had even started! From this, we were able to get a constant flow of money throughout the year that helped fund trips to companies, social events, and even an international trip to Amsterdam.

Moving forward, the then Publicity Officer (Sam Read) and I, decided that a lot of value could be garnered from a student magazine which focused on the academic side of the department. it would give students the opportunity to find out about the world class research that takes place in the department and eventually could be used to publicise to external bodies such as school students and companies, to give them an idea of exactly what it means to be a Materials Scientist (I'm tired of having to explain what my degree is!). In time, I hope that the magazine will also help bridge the gap between current students and alumnui of the department. As with sponsorship, the magazine was the first time our society has attempted to do something of this scale, and although slightly behind schedule we managed to get the first edition of the Matsoc Magazine out, which was a success in itself. My most important act as President, however, was introducing the roles of Sponsorship Officer and Magazine Officer, in the hope that these two combined would ensure the future of MatSoc. I'm hopeful that those that come after me will have a better experience of Imperial as a result. I'll end by offering some advice to students, if you truly believe that Imperial is a world class institution worthy of its reputation, then you will get involved with a society. Any society. Strive for positive change and don't blindly accept that the university will retain its world class status, as much of its reputation is built from research and not student experience. It takes active staff in the department and moreover an active student body working in tandem to form a truly world class experience.

Gethin Banks

MatSoc President (2016-2017)

IMPERIAL MATERIALS Est. 1851

Materials Careers Fair 2017:

A First and a Success

The MatSoc committee began working over Summer to organise an inaugural Materials Careers Fair. A vast range of companies attended and the event was a profound success.

In the afternoon on Wednesday the 1st of November, the Materials Careers Fair took place, a first for the department and for MatSoc. This was unquestionably a remarkable success with visiting companies, staff and students alike complimenting the organisation and execution of the event. On explaining that this was the first time MatSoc had coordinated a careers fair and that this was the first project completed by the committee, we were continually met with astonishment. We hope that this afternoon was useful for the vast number of students that attended and that future committees will consider running a similar event.

"Very successful event, well organised, a credit to the department!"

-Attending company

Preparation began long before the academic year and continued over the course of four to five months. Particular thanks to Abigael Bamgboye (MatSoc Vice President) and Dylan Hall (MatSoc Sponsorship Officer) for contacting and inviting companies to attend the event during the Summer break. Following this, events management and hospitality had to be arranged. Nikesh Patel (MatSoc Honorary Secretary) and Marta Wolinska (MatSoc Events Officer) booked the venue, ensured health and safety regulations were observed and organised the provision of refreshments. Amy Tall (MatSoc Magazine Officer) and Schan Dissanayake-Perera (MatSoc Publicity Officer) created publicity material and compiled useful information (e.g. biographies of attending companies, a floor plan, ICL and departmental careers service information) into a stylish brochure that complimented the professionalism with which the event was conducted. Zack Jeanrenaud (MatSoc Junior Treasurer) interfaced between the Imperial College Union and the chosen printing company to ensure that these brochures were printed and delivered prior to the fair. Harriet Frier (MatSoc President) oversaw organisation of the event and allocated the necessary tasks to the previously mentioned committee members. Furthermore, while the careers fair was dominating most members activities, Christopher Keegan (MatSoc Webmaster) was updating the MatSoc website with member biographies and sponsorship information. Additionally, thanks is extended to Alice Robinson (Academic Departmental Representative) who is treated as an honorary member of MatSoc and continues to provide her valued advice. We also show gratitude to the Department of Materials itself. Staff members were in full support of a careers fair and the department generously

" I applied to two internships as a result of the careers fair, and it gave me a chance to think more productively about my career path"

-2nd year Materials student

Students, from all years, networking and making the most of the event

Publicity poster indicating companies/ institutions that attended

Covered the cost of the event in its entirety.

The committee decided to organise this event because we have found that there is commonly a lack of provision for Materials Science and Engineering students at general engineering/science careers fairs and forums. This is likely due to the lack of knowledge of what our degree actually entails, yet, qualified Materials Scientists and Engineers are sought after in industry. Thus, we wanted to arrange an event that would facilitate a dialogue between Materials students and companies that actively recruit in the field of Materials.

An impressive range of companies and institutions attended the event. All of MatSoc's sponsors took part (see pages 8-9 for more information) and stands were also held by IOM3 and SPE promoting student membership. Furthermore, some start-up companies were present, including Imperial's own ThinAir (see pages 24-25).

We would like to extend many thanks to all companies and organisations that attended the event and helped to make it so successful.

IMPERIAL MATERIALS Est. 1851

Sponsors of MatSoc:

Sponsorship Officer's Report

Dylan Hall, MatSoc's Sponsorship Officer, explains his responsibilities, discusses the benefits that sponsorship provides and reveals MatSoc's sponsors for the 2017/2018 academic year.

Sponsorship Officer is a new role in MatSoc this year, which was introduced in order to help us bring extra money into the society. A large budget for the society allows us to subsidise more academic and social events throughout the year, and to put on an international tour for students at the end of the academic year.

My role is to contact companies in the engineering and finance sectors in order to secure sponsorship for MatSoc. I started in April by working on a sponsorship proposal that explains what MatSoc is, what we can offer sponsors, and the ways in which we use sponsorship money. Since then, I have sent out hundreds of sponsorship invitations to companies that are well aligned with our department. As you might expect, it takes many emails and phone calls before the right company will agree to sponsor you, but once I managed to established some good contacts, I was able to start discussing sponsorship packages.

We have five official sponsors for the 2017-18 academic year; TTP as our Gold sponsors, Nucleargraduates and Zotefoams as our two Silver sponsors, BP as our 4th sponsor and Chartwell Consulting as our 5th sponsor.

In return for the sponsorship fee, we offer sponsors the best possible links to students in the department. In addition, there are a number of other benefits such as brand advertisement, which we achieve using our website, email and social media pages.

It was fantastic to have all five of our sponsors at the 2017 Materials Careers Fair, as they helped to make the event a success by offering students useful information about upcoming graduate opportunities and internships. Following the success of this event, we are hoping that the Materials Careers Fair becomes an annual event that all of our sponsors attend.

I have put a lot of time into this position because I think that it's important for MatSoc to have a range of different sponsors - partly because of the freedom that a good budget gives us, but also because it helps improve our image as a society. We are planning to continue subsidising lots of events throughout the rest of the year, and hopefully we get the same great turnout from students that we have had so far!

Ultimately, our sponsors are interested in having great links to Materials students for graduate opportunities and internships, so if you like the sound of a role available at one of these companies, I encourage that you apply. You have the benefit of knowing that these companies are already interested in you – just from the course that you study, and you will receive detailed information about these opportunities directly from MatSoc.

Some of our sponsors engaging with students at the Materials Careers Fair

A selection of the MatSoc committee sporting TTP branded trip T-shirts

IMPERIAL MATERIALS Est. 1851

Summer Science Exhibition 2017:

“Festival of Science” by The Royal Society

Two second year students, Schan Perera and Anthony Onwuli, attended the exhibition. Anthony comments on the exhibit as a whole, while Schan focusses on “Amazing Masers”.

The Royal Society Summer Exhibition was an amazing day for science communication as many research groups were present. Many of the exhibits were closely related to the field of materials, including Imperial College’s “Amazing Masers” group; the world’s first group to ever discover a way to make a room temperature maser from an organic crystal molecule! I had the pleasure of building a model of pentacene which is the dopant in p-terphenyl for the gain medium in this maser.

Another exhibit which made use of the wonderful science of materials were “A Future Without Fakes”, (FWFakes, a Lancaster University research group) which made use of the presence of defects in 2D materials as a method of detecting for counterfeit products.

Alongside communications, and preventing the sale of counterfeit products, materials science can also be implemented in the medical field with the development of “Smart surfaces”, a UCL research group. These smart surfaces are both antimicrobial and hydrophobic. These properties enable these materials to be self-cleaning as they repel water off of their surface. Furthermore, unlike antibiotics, bacteria won’t become resistant to these surfaces; with further development, we can avoid the “antibiotic apocalypse”**!**

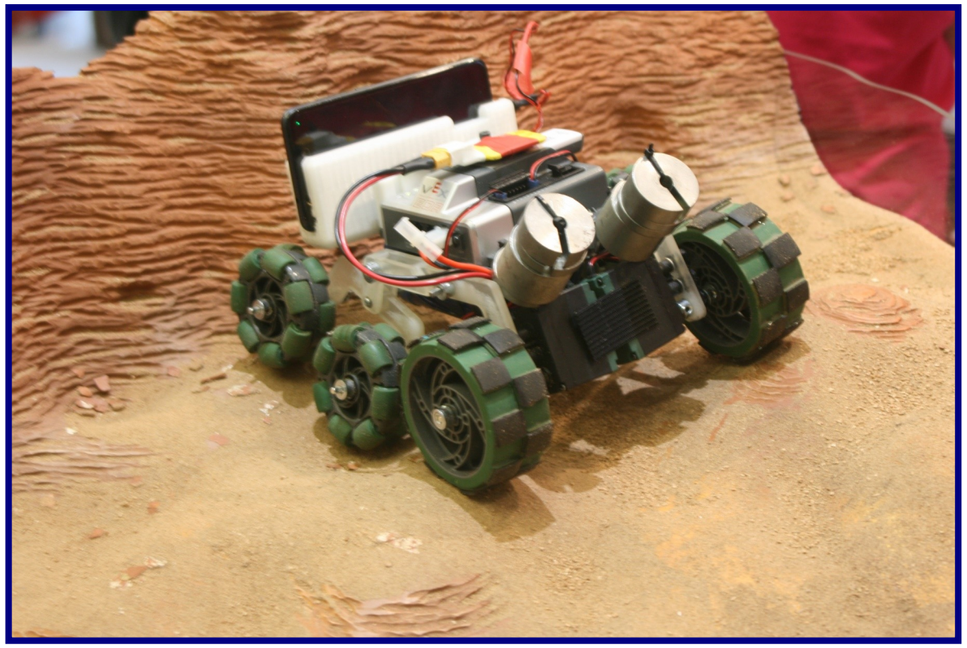
By Anthony Onwuli

Every summer The Royal Society puts on a week long ‘festival of science’. Jam packed with exhibits and talks celebrating the cutting edge of UK science, the event attracts enthusiasts of all ages. This year, I was one of those enthusiasts.

Having never been to The Royal Society’s main venue before I wasn’t sure what to expect, perhaps a dark old building with ancient Bunsen burners and equally ancient exhibitors. I was glad to see that my preconception was way off and I was greeted by smiling stewards in colourful t-shirts who led me inside to the main hall which was buzzing with energy and enthusiasm. This event was by no means a scientific ‘conference’. It was clear that everyone attending was there to have a good time and everyone exhibiting was there to engage and inspire.

The Amazing Masers exhibit was my main reason for making the trek up to London. Quite a few members of the department are involved in this project, including some big names such as **Prof. Alford, Prof. Haynes, Dr Heutz, Dr Horsfield and Dr Oxborrow (among many others!)** and so there was some added incentive to come and show my support and learn about a part of Materials Science that was brand new to me.

At the centre of the Amazing Masers exhibit was a radio-controlled model of the Mars Rover on a lovingly crafted piece of Mars terrain. The rover could be controlled by the camera mounted on its back so the person holding the controller had to rely

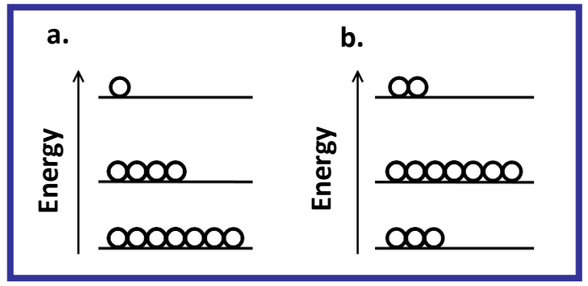


RC Mars Rover Model used to demonstrate the effect of “noise” on communications

on the image on the screen to move the model. Meanwhile someone else could twist a few knobs to simulate interference in the communications, making the image on the screen go all blurry, thus making it harder to control. The idea behind this was to be able to demonstrate how important it is to increase the signal to noise ratio to allow for effective communication and to build up to a solution to this problem of noise: Masers!

We’ve all heard of Lasers before, **L**ight **A**mplification by **S**timulated **E**mission of **R**adiation, is the acronym we’ve all memorised for an exam at some point, but a lesser known fact is that the MASER came first. Instead of amplifying visible light, Masers do exactly the same for microwaves. We’ve been using Masers for a long time, mainly in applications where information needs to be transferred across very large distances (hence the Mars Rover at the exhibit). Masers are ideal for this application because they can massively amplify microwave signals without also amplifying the interference, greatly increasing the signal to noise ratio.

A main component of Masers is the gain medium. In a solid-state maser, light is directed into the gain medium causing electrons to excite to higher energy levels and then drop back down, emitting photons which then go on to do the same for many more electrons (hence ‘Amplification’). A key requirement for the gain medium is for there to be population inversion, which essentially means that there are more electrons in the upper state than the lower. The reason Masers haven’t been more widely used is that traditionally they require refrigeration and to be held in a strong magnetic field to maintain this population inversion.



a. indicates a normal distribution of electrons. b. shows population inversion

IMPERIAL MATERIALS Est. 1851

To date ruby has been used as a gain medium due to it containing paramagnetic ions, however, as mentioned above they are required to be cooled to below 10K and exposed to a strong magnetic field; this poses obvious engineering difficulties. The innovation and relevance to materials science comes in the form of a new alternative to ruby which operates at room temperature and in the Earth's magnetic field. The research team made their breakthrough by substituting ruby for a soft, organic polymer: p-terphenyl doped with pentacene. This new maser operates by completely different mechanisms than the traditional masers, utilising a phenomenon called "spin-selective intersystem crossing", which is still not fully understood. This is a real win for masers which, soon, will hopefully be used much more widely.

Prof. Neil Alford (ICL)

I had an interesting discussion with a few of the exhibitors at the exhibition. I asked Prof. Alford about the main limitation of their new maser, the fact that they currently are only able to operate in short pulses rather than continuously. As a MatSoc magazine exclusive he revealed that a bit earlier in the year in March they had successfully managed to develop a new gain medium which operates continuously but were still waiting on articles to be written up and published so this was most certainly on the down low but still very exciting news!

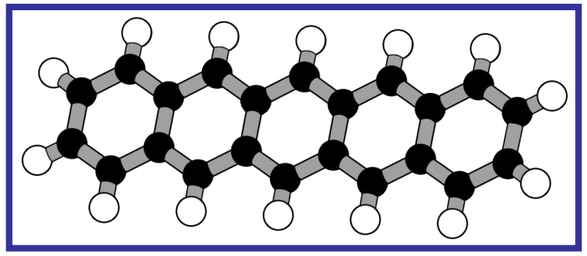
Dr Ricardo Montis (ICL)

I was also able to talk to one of the chemists involved in the growth of the p-terphenyl/pentacene crystals used as the gain medium. Dr Montis said the main technical difficulty in this project was finding an appropriate method to grow the gain medium crystals. The maser crystal was successfully grown using the Bridgman-Stockbarger method which involves growing crystals from melt in a cylindrical, silica crucible.

Personally I feel that I benefited greatly from attending the event, not only learning about some cutting edge science but also seeing how rewarding it can be to share your research as an academic.

I think the Amazing Masers team did a fantastic job making their research accessible and I'd be surprised if they didn't inspire a few future Materials Scientists in the process, they certainly inspired me.

By Schan Dissanayake-Perera



Model of a pentacene molecule

Dr Enrico Salvadori (UCL) holding a model of pentacene

Anthony Onwuli getting hands on and attempting to construct pentacene

IMPERIAL MATERIALS Est. 1851

Lecture Series:

Going Further With Materials

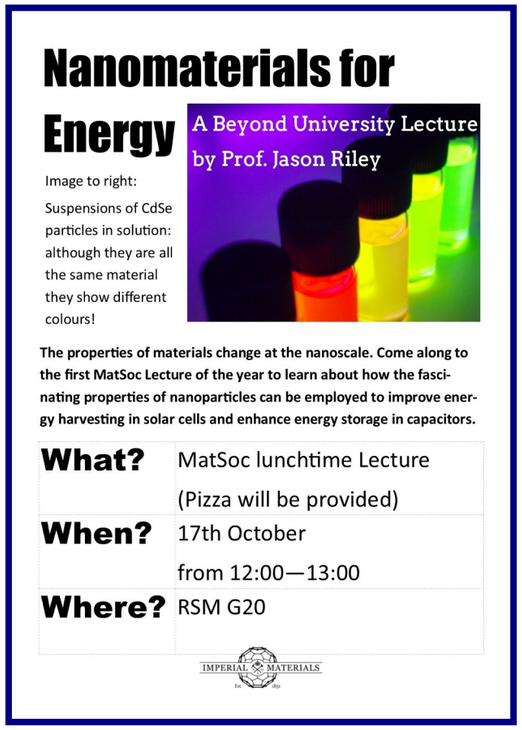
MatSoc organise two optional lecture programmes. One of these involves career/industry based information while the other gives an insight into current departmental research.

The MatSoc Lecture series is a fortnightly programme where lecturers discuss exciting trends in their area of research and/or present interesting findings from their own work. It's a chance for students to witness how Materials Science and Engineering is shaping the world, and how it will continue to do so in the future. It also provides an opportunity to consolidate learning and communicates the activities that take place in the department beyond undergraduate teaching.

This term, lectures presented were:

- ***Nanomaterials for energy—Prof. Jason Riley: An exciting insight into how nanoparticles can be used to facilitate energy harvesting in solar cells and energy storage in capacitors.***

- **Putting some bounce in bio-glass for joint repair—Prof. Julian Jones: *A discussion about the success of bio-glass as a regenerative tissue scaffold for orthopaedic and dental applications and the suggestion of continued development which could lead to a material that could be used to replace cartilage .***



Promotional poster for the "MatSoc lecture series"

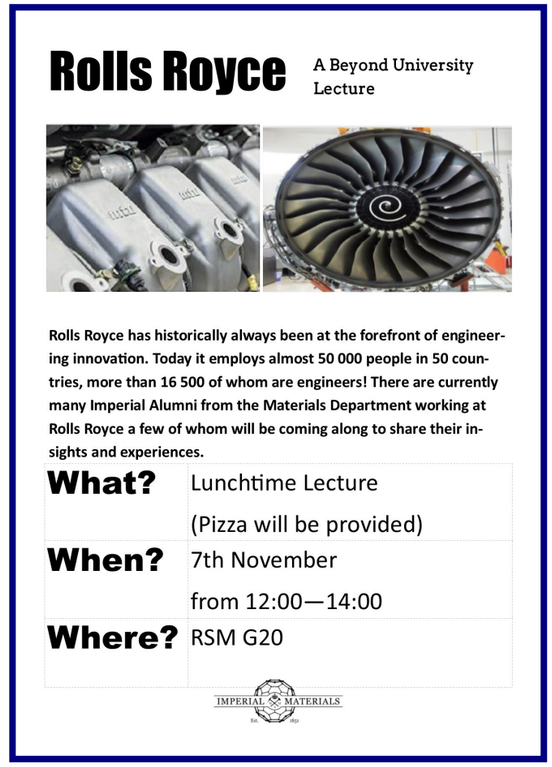
The Beyond University Lecture series is a chance for students to meet with industry, and learn how leading companies are using Materials Science and Engineering in their work. In a typical lecture, we often discover interesting and varied career stories- from those of recent graduates to senior employees' and see interesting technical case studies.

We also receive advice about how to apply for internship and graduate opportunities, and use an open Q&A to enquire about the technical aspects of the company's work, and discuss making the best possible application stand out.

This term, lectures presented were:

- ***Rolls Royce: An informative talk in which students were told about Rolls Royce's placements and advised on the qualities Rolls Royce values in its employees.***

- ***SPE– Guest Speaker: A PhD student at ICL, employed by Nextek, shares his experiences in the polymer industry. He discusses the research that took place at ICL regarding polymer resin produced from used disposable coffee cups and the NextCupCycle project.***



Promotional poster for the "Beyond University" lecture series.

A close-packed lecture theatre for Prof. Julian Jones' lecture on bio-glass

Plywood:

Material of the Modern World

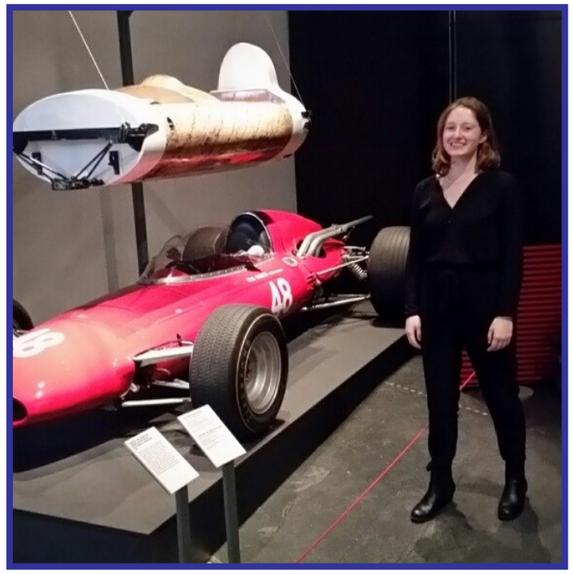
Helen Money-Kyrle, a second year student, reports on her visit to "Plywood: Material of the Modern World", an exhibition displayed at the V&A between July and November 2017.

Often overlooked, plywood's story is a fascinating account of how social-political and technological factors have influenced the development of what was once a new material, and which now can be found everywhere in our modern world. Its lightness, strength and flexibility, along with the ease with which it can be produced means that plywood has been used in everything from aircraft to dinghies, and from surf boards to leg splints.

The Victoria and Albert Museum's autumn exhibition 'Plywood: Material of the Modern World' is a world-first, giving a unique insight into the development of what was a new material into one which is now commonplace, while challenging visitors to question why plywood is so often thought of as the underdog of materials.

Plywood is a composite material made of thin veneers (layers) of wood which are held together by a resin. Each layer of the wood is rotated at an angle of up to 90 degrees. This cross-graining means that the plywood is of a consistent strength across the whole panel; unlike ordinary wood which is anisotropic, being stronger along the grain than across it.

The core veneers are often made of lower strength wood, as their primary function is to increase the separation between the outer layers, which is where the bending stresses are highest. One side of the panel is in tension, and the other in compression,



Helen admiring a racing car fuselage

with the bending stresses nearly at zero at the central layer. In contrast, the shear stresses are greatest in the centre of the panel and at the edges of the layers. An odd number of layers are used, which balances the sheet and reduces warping.

The first use of plywood was in ancient Egypt in 2600 BCE, where cross-grained veneers were layered to make a material stronger than wood; but plywood didn't become widely used until the 1790s, when veneering techniques were patented by British naval engineer Samuel Bentham. Plywood started to be used in furniture, and became widely used in the 1850s on the invention of the rotary lathe by Immanuel Nobel.

Cross section of an old automobile illustrating the extensive use of Plywood

This massively sped up the veneering process, enabling plywood to be mass produced on an industrial scale.

In the early 20th century plywood massively influenced aeroplane design. Novel experiments with moulded plywood enabled the invention of the first enclosed, streamlined 'monocoque' fuselages. The British 'Mosquito' (DH-98) was the fastest, highest-flying aeroplane of World War II, designed with a high-strength plywood fuselage made of mahogany and birch with adhesives resistant to extreme heat and humidity. The use of this material made it lighter, quicker, and cheaper to produce than metal planes.

The invention of synthetic glues allowed for the manufacture of new waterproof plywood. During the Great Depression in America in 1930s, this plywood was used for the exterior of cheap temporary housing that could be mass produced in factories and assembled in less than 24 hours onsite.

In the 1940s, Charles and Ray Eames experimented with moulding plywood into complex forms, making leg splints for the US Navy which could be mass produced and stacked so that they could be easily transported. This influenced Charles and Ray Eames' later work in architecture and furniture, where they exploited plywood's ability to be moulded into curved forms. As well as being used in architecture and furniture that we buy, plywood enabled an explosion of do-it-yourself during the late 20th century, with plywood kits and designs produced and distributed to make objects such as the Mirror dinghy, which used a marine grade waterproof plywood.

What does the future hold for plywood? With modern manufacturing methods, a log can be veneered in only seven seconds, making plywood easy and relatively cheap to manufacture. As well as its use in many household items, it is used by distributed manufacturers such as Opendesk, which sell files for the cutting of plywood parts over the internet, reducing the need for shipping items across the world and allowing people to produce their own furniture close to home. New spindleless lathes mean that we can now veneer coconut trees, enabling small communities to make sustainable and economically viable use of old and unproductive coconut trees.

Think of it what you will, plywood really is a material of the modern world.

IMPERIAL MATERIALS Est. 1851

Materials of Design Symposium:

The History of Materials and their Application

Amy Tall, MatSoc's magazine officer and a 2nd year student, attended a symposium related to the V&A's Plywood exhibition considering the history and progression of materials use.

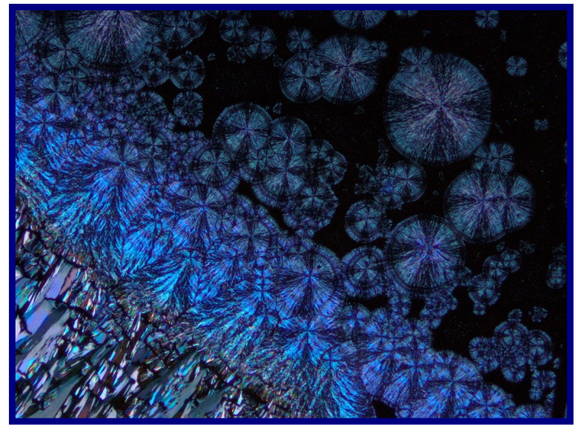
Having visited the V&A's fantastic Plywood exhibition with Helen (see pages 16-17), I decided to attend the related "Materials of Design Symposium" held at the V&A on Friday the 6th of October. This was described as an event that would consider the history of materials application between 1850 and modern times, in the context of politics, economics, geography and social context. In reality, it considered these factors among many others and provided a scientific insight into new and modern materials such as self healing concrete, synthetic organs and organic light-emitting diodes (OLED's).

I am sure most readers will be familiar with the work of the first speaker: Prof. Mark Miodownik (UCL). In his talk, Miodownik explained the distinction that most people make between "things": living and non-living. Yet, he explains that distinction is becoming less clear cut due to our increased understanding of the science of matter. For example, materials science is paving the way for us to rebuild and repair the human body (consider the use of bio-glass discussed in Prof. Julian Jones' MatSoc lecture). Furthermore, 3D printing enables bespoke solutions such as prosthetic limbs and ongoing research into synthetic organs. The analogy was then extended to the reverse situation. In Miodownik's opinion, our man-made environment is becoming more lifelike with the adoption of self-healing and self-assembling materials. Thus, he considers us to be in a transitional period and is eagerly awaiting the advent of a new materials age.

As discussed by Helen (pages 16-17), plywood has often been considered a cheap and undesirable material. Plywood furniture is veneered to hide the true nature of the material, the very material that allows complex and intricate shapes to be achieved. The second speaker, Dr Alistair Grant, discussed the coating of another material: metal. He explained that electroplating, on its discovery, was marketed as a "technological marvel". Cheap alloys were coated in thin layers of precious metal. Simply, this is deception. Yet, the Victorian's did not treat these fraudulent items with scorn. Quite the opposite, they were an embodiment of modernity and something desirable, despite their cheap and mass manufacturable nature. This is a direct contrast to the treatment of veneered manufactured board. We are surrounded by it, yet we still place a higher value on solid wooden furniture, despite its impracticalities. Perhaps this returns to the distinction of living and non-living addressed by Miodownik. Maybe we instinctively recognise wood as a natural material and something that should not be tampered with. As the lines between living and non-living continue to blur, will we finally begin to appreciate manufactured boards as opposed to just begrudgingly utilising them? This is labouring a philosophical point, however, it is refreshing to consider the human interaction with materials. As Materials Scientists and Engineers we are of course accepting and interested by most materials, but, the general public may have a different view. Did you ever meet someone reluctant to purchase a Kindle because: "it's just not the same as a paper book"? Essentially, it requires more than just the innovation of a useful material or technology for the public to accept and appreciate it, a fact that is often overlooked.

Though the morning was informative and provided historical insight, the afternoon was the highlight of the event, focussing on the future of materials.

Relating to the Plywood exhibition, we were first told about a project designed to empower local communities on Islands of the South Pacific. This involves the production of veneer and other items from senile coconut palms. Coconut palms are technically a grass, not a tree, thus, they have only axial and no radial structures and as such easily split along the grain. They have a structure consisting of vascular bundles in a spongy matrix that is near homogenous. Furthermore, there is a significant variation in the density of the material. On the outer edges of the palm, a tube of dense material is formed to support the structure, however, in the centre there is a much lower density. Another feature is that coconut palms do not grow branches. The absence of branches, knots and other defects commonly found in wood from trees theoretically results in a more attractive and better quality veneer. However, the vascular bundles means that the surface is rough and therefore difficult to glue. Utilising these senile trees posed a significant technical challenge. Conventional rotary lathes have a spindle and grip logs in the centre, however, coconut palm logs have such a low density in the centre that this is not feasible. Thus, spindleless lathes were developed and local people taught how to recover veneer from the palms. A sustainable industry that will improve the lives of many has been established through advances in technology and process development regarding a single material.



Microscope image of an organic polymer blend-observe the presence of spherulites. Image provided by Dr Jessica Wade

Dr Jessica Wade (ICL) ended the day with a significant change of pace by considering electronics and energy. She explained that the science behind solar cells is well established, however, there are some significant problems: lack of efficiency, labour intensive production and difficulties extracting silicon to list only a few. Silicon is a semiconductor and solar cells function due to a layer of p-type and n-type silicon being sandwiched together to create a p-n junction. Light photons hit the solar cell and excite electrons enabling them to move across this junction -current flows and electricity is produced. Now, however, people are considering the use of polymer semiconductors as they are cheaper, more flexible and more easily processed. Furthermore, conjugated organic molecules exhibit a band gap allowing the emission of colours different to those absorbed and can be printed as a functional ink. The possibilities are endless—electronic paper, wearable technology and flexible displays are all possible applications.

Overall, the event provided an insight into the history of some materials and considered futuristic materials applications. The perspective of the user, designer and engineer were addressed with the aim of bridging the gap between design and science.

IMPERIAL MATERIALS Est. 1851

Investigating Industry:

Visit to the Nampak Plant at Oakthorpe Dairy

MatSoc and the ICL student chapter of SPE arranged a trip for those interested in polymer prcoessing. Lawrence Good and Kathryn Bailey, third year students, report on the event.

Being at Imperial, it can sometimes feel that plastics are a bit of an afterthought. The industrial juggernaut that makes most of the products we use in everyday life gets left behind by the worlds of fancy polymers, exotic bioglasses and the ever-present trumpeting of hi-tech alloys. Well, the Society for Plastics Engineers (SPE) decided that enough was enough, and took a bunch of intrepid MatSci students for a trip of a lifetime. And when that proved a smidgen ambitious, to a dairy near Haringey instead.

We visited a plant run by Nampak, a South African company with a sizeable UK branch. Their mother-plants in Stirling and Milton are supported by a number of satellite plants, each supplying a specific customer with bottles tailored to suit their needs.

Oakthorpe Dairy, which we visited, has two main sections. The first building was Nampak's satellite plant. A large hall plays host to 6 blow-moulding machines, each set up to produce a specific kind of milk bottle. After a curtain of semi-molten plastic is clamped into a mould, a burst of air pushes the bottle into shape. The bottle is popped out and trimmed down to shape, with the entire manufacturing process taking only 7.5 seconds. Conveyed across the room the bottles are then subjected to an array of stringent quality control tests. This stage of the process was invariably accompanied by a gaggle of gawking 3rd years desperately searching for even the slightest solutions to their design projects! The bottles were then moved upstairs, where they were packaged and stored, before being unpackaged and sent through to the dairy. They then snaked around the room, being filled, sealed and labelled before being loaded onto pallets and into lorries, ready for delivery.

"What could have been better than an industrial visit to a plastic factory to see the theory covered in "Synthesis of Polymers" laboratory exercises being used in practise? Although the health and safety induction was long, we sat through it interjecting with questions about milk bottles (and fiddling with free pens!). But after a thorough tour of the factory-with head gear, safety jackets and ear plugs on, most of our questions were answered! It was an amazing experience to see the intricacies that went into manufacturing milk bottles on such a huge scale - from making the polymer using recycled plastic, to injection moulding, defect detection and the storage, filling and capping of the bottles! And despite that, the speed was crazy! (polymers turning into milk bottles in the blink of an eye!). Also, besides the technical aspects, we got first hand insights about the work life of employees. It was great to talk to MatSci students from other year groups over lunch as well!"

-Paridhi Poddar, 2nd year Materials

Trip participants trading lab coats for high-vis jackets

The heads of the more conscientious of our number were turned not by the hydraulic glitz of the moulding process, but by the rather impressive feats of recycling and waste production. When making the bottles, two main streams of plastic are used. Pure high density polyethylene (HDPE) makes up 80% of the bottle, with recycled HDPE making up the rest. The slight green tinge of the rHDPE is what gives milk bottles their translucent appearance. Similarly, this green colour makes milk buyers uncomfortable, and customer desire for a white bottle prevents increases in the proportion of recycled plastic from being any more than marginal increments. The reusing of material didn't end there though. Offcuts from the moulding process, as well as the rejected and deformed bottles are collected up and thrown into big crushing and dicing machines. The plastic is melted down, then reformed into beads and flakes before being reincorporated into the feedstock and made into more bottles.

Packaging is one of those major industries that rarely gets mentioned, except with regards to pollution or environmental damage. Our trip showed us the engineering, thought and potential careers that can be pursued dedicated not only to ensuring good products, but to improving sustainability in the industry. For example, a simple yet effective design modification, the "Infini" model (milk bottles with handles on the corners), results in the use of 20% less plastic than its centrally handled predecessor.

This trip revealed the scope of the plastic manufacturing industry and reminded us that seemingly simple, everyday objects require continual design and development.

SOCIETY OF PLASTICS ENGINEERS

IMPERIAL MATERIALS Est. 1851

Russia-UK Raw Materials Dialogue:

Major Elements of Sustainable Development

Abigael Bamgboye, MatSoc's VP and a second year student, attended the dialogue. She discusses some of the key issues raised from the perspective of industry.

As Materials Scientists and Engineers, our discipline aims to utilise and enhance the properties of rare earth metals, common transition elements and interesting non-metals. But how often do we consider the technical challenges and socio-political factors involved in obtaining the raw materials that allow us to develop materials technologies?

The Russian-UK Materials Dialogue brought these issues to light and provided a forum for mining engineers, materials scientists and geotechnical engineers to discuss challenges to the industry and supply chain.

The two-day conference, which took place in Russia, was a collaboration between the Institute of Materials, Minerals and Mining (IOM3) and the St Petersburg Mining University—a major producer of mining professionals in Russia. Four panel sessions took place over two days.

In particular, the first two days provided a wealth of commercial insight, which is discussed below. The second day of the conference looked at how sharing expertise and knowledge could drive forward both the UK and Russian raw materials sectors. Both face similar economic and environmental challenges, and interestingly suffer from another problem; recruiting talent. As with most engineering and technical disciplines, the skills gaps is a considerable issue which the mining and raw materials industries will continue to face in the future.

Over two days, the four panel sessions that took place were:

- ***Trends in the production of energy resources, mineral raw resources and materials in the modern world***
- ***Possibilities and constraints presented by the Circular Economy model***
- ***Problems and prospects of Russian-UK cooperation in the mineral resources sector***
- ***The role of universities and professional communities in the training and development of competent professional engineers for the raw materials industries***

The conference raised many interesting questions. I have selected three of the most prevalent to consider and discuss for the purpose of this article.

"Energy profiles in different countries are vastly different, but what is the overall change in real time?"

As evidenced by the volume of energy material related research that goes on within our department and at other universities, energy resources are a major topic in the global sphere. The Russian-UK dialogue provided a fascinating insight into opposing energy markets between Russia and the UK and other European nations. While Russia predominantly depends on its extensive oil and natural gas reserves, the UK's energy balance has changed significantly over the last century, and is continuing to do so with the increasing adoption of renewable energy. Personally, I was shocked to see how fast this change has been occurring, and I'm prompted to follow along with much more fervour. The trend in the UK is mirrored across Europe, leading to exciting investment in research of energy storage and energy harvesting optimisation (such as that discussed in Prof. Jason Riley's MatSoc Lecture on 17th October).

"What are the environmental implications of obtaining raw materials?"

Finding ways of processing existing materials more sustainably, cheaply and with fewer toxic by-products is one way that our discipline interfaces with environmental considerations, but, have you ever considered the waste products and pollution caused by getting the raw elements out of the ground? This was a question that had never crossed my mind, so it was intriguing to see how environmental professionals were looking at mine regeneration, and further extraction from existing mines.

"Is the circular economy model a viable business framework?"

The circular economy describes a method of creating products which can be recycled into new products once their current lifecycle has elapsed. The opposite of the circular model is the linear model which describes obtaining a raw material, processing it and then throwing away the end-product. This likely seems much more familiar. For various reasons, the linear model has dominated as an easy way to mass produce goods. But with limited space for landfills, and the financial and environmental benefits of recycling, it's not surprising that the circular economy has become a buzzphrase to be employed when considering sustainability in industry. The main challenge to the widespread adoption of this mindset, I noticed, was the financial implications of changing production processes; the potential expense makes it less attractive for many parts of industry.

Abigael Bamgboye with Chimdi Igwe, a third year student, at the conference.

Overall, the conference was a wonderful chance to meet with professionals across the materials, mining and minerals industries, and to learn about the challenges facing raw materials procurement; a topic I had not previously considered. The trip was made possible through a generous bursary provided by IOM3, so I encourage Materials students to obtain student membership and explore the various opportunities and lectures hosted by the institute.

I'm looking forward to exploring the topics discussed in the future, and encourage you to have a look at the IOM3 website, Materials World and to keep an eye out for next year's Russian-UK Materials Dialogue which is due to take place in London in 2018.

IMPERIAL MATERIALS Est. 1851

ThinAir:

Providing Water For Anyone, Anywhere

Muhammed (Maks) Maktari, 4th year student, is the Chief Engineer for ThinAir, an ICL start -up company. The progression and successes of the company are discussed below.

ThinAir was founded by 5 Imperial undergraduate students, all in their third year of study at the time of conception (now in 4th year). The founding team was Jonathan Risley (Biotechnology), Sam Bruggen (Biochemistry), Muhammed (Maks) Maktari (Materials Science), Jansen Teng (Biotechnology), and Emily Goh (Biochemistry).

During the first few months the team worked hard to develop a solution for their initial idea of harnessing the colossal resource of atmospheric water. Within a few months, the foundations of their solution had been conceptualised. Using a combination of biochemistry, biomimicry and materials science, and thus harnessing the diverse skill-set within the team, they developed the concept of their highly efficient water condensing membrane. This solution encompasses a range of optimisations to collect water at high efficiency, even in dry environments.

The next steps for ThinAir were raising funds and gaining recognition from key players in the industry. They entered into a myriad of competitions and proceeded to win 5 of them, and achieve top three in many others. Their awards to date include "Student Startup of the Year", 1st Place in McKinsey Venture Academy and 1st Place in the LBS CleanTech Challenge Winner. Most recently, ThinAir have been accepted onto the prestigious Climate-KIC Accelerator Programme, and are also competing in the XPRIZE Water Abundance Initiative.

Throughout the process of taking part in these challenging competitions, ThinAir have been very fortunate to have come into contact with a broad range of industry experts, such as the former Mayor of Palo Alto, who now acts as ThinAir's water policy advisor. They have also been in communication with farms in the US and Australia who are keen to utilise ThinAir's unique technology to improve the efficiency and sustainability of their crop production, as well as other companies and charities who are keen to integrate the technology into their own solutions.

'To tackle the world's water crisis, in which 844 million people currently lack access to clean water and by 2025 two- thirds of the world's population will face water shortages, ThinAir have designed a special surface to capture water from the atmosphere. There are animals in nature, such as the Fogstand beetle, which has a natural ability to condense water from the atmosphere. We have applied these principles along with a novel protein layer onto a scalable membrane to harness the 140 quadrillion litres of water in the air around us.'
-Excerpt from one of ThinAir's papers

Since forming the team in 2016, ThinAir have raised over £100,000 through competition wins and grants. This money has been used to fund lab space, equipment, intellectual property, and marketing efforts.

Left-right: Jonathon Risley, Jansen Teng, Emily Goh, Muhammed (Maks) Maktari, Sam Bruggen

ThinAir are now in the process of finalising their membrane and working with experts in the field to maximise it's efficiency and further discuss its potential applications. Alongside farms, the technology could be used for refugees on the move, on the currently unused space beneath solar panels to provide water for crops and even in space to recycle water used during space exploration.

ThinAir incorporated in April 2017. Jonathan takes the role as CEO and is currently working full time for the business, covering daily duties such as meeting with investors and stakeholders. Sam takes the role of COO, making use of skills he is learning during his masters in Management at Imperial Business School to help strategise the company's direction. Maks is Chief Engineer, utilising his Materials Science background to optimise the membrane surface, and Jensen is CTO, using his biotechnology background to develop the biological aspect of the membrane. Unfortunately, Emily was required to return to Malaysia on a company contract, but still keeps up with the team's progress and was a key contributor to ThinAir's early success.

Over the next few months, ThinAir aim to finalise their technology and continue talks with potential customers about how they can implement their technology, as well as filing for their patent to protect the technology.

Throughout 2018, the ThinAir bio-membrane will be scaled up and piloted in the UK, followed by pilot projects in Zimbabwe and California. ThinAir will also look to gain further financing through funding rounds and crowdfunding.

The future of the company will involve operating with two branches. The first branch will cover commercial applications of the technology. The profit from the commercial branch will be reinvested into a humanitarian branch.

This branch will help to serve the ultimate goal of the company - providing access to clean water for the communities that need it most.

IMPERIAL MATERIALS Est. 1851

Investigating Industry:

Visit to the Culham Centre for Fusion Energy

Connor McCraith, currently in second year, reflects on his experience of a MatSoc (previous committee) organised trip to the Culham Centre he attended in his first year.

On the 2nd of February the Materials Society ran a day trip to the Culham Centre for Fusion energy in Oxfordshire. This encompassed viewing the largest operational nuclear fusion reactor in the world (JET-the Joint European Torus) and the new facilities being built at the Materials Research Facility also on site. The trip was a chance for those students with a budding interest in the capacity for Nuclear energy to take a more prominent role in considering the provision of humanities energy needs. Additionally, it was an opportunity to gain insight into the cutting-edge research going into materials for future reactors such as ITER (International Thermonuclear Experimental Reactor).

Upon our arrival at the centre we were split into two groups with one being shown the reactor first whilst the others were given a tour of the materials research facility. Those of us viewing the reactor were brought through the massive 1100 tonne blast doors and into the section housing the enormous machine. We were briefed with the basic theory of nuclear fusion and how a Tokamak design fusion reactor enables the reaction to occur.

Nuclear fusion differs from traditional fission reactors. Instead of 'splitting' large nuclei usually Uranium or Plutonium isotopes, two small nuclei are smashed together to fuse into larger nuclei giving off enormous amounts of energy due to the lowering of energy on combination. This process is energetically intensive to initiate due to the strong Coulomb repulsion force that is generated whilst bringing two positively charged nuclei together. As such, the isotopes of Hydrogen (deuterium (21H) and tritium (31H)) are most widely used as fuels in fusion projects. They only have one proton, are abundant on Earth and produce Helium as a by-product. These fuels are heated up into a plasma (an ionized gas of positive ions and free electrons) at over 100 million degrees Celsius where they then have enough energy to overcome the coulomb barrier and get close enough to each other for the Strong Nuclear Force to take over. This heating is often provided using several complimentary methods such as Ohmic heating (generating heat by passing a large current through a conductor in this case the plasma) and Neutral Beam Injection (injecting high energy neutral particles into the plasma to provide energy through collisions).

There are many designs that have been produced for potential nuclear fusion reactors but the one which has received the most research and success has been the Tokamak. This approach involves confining the superheated plasma mixture in a twisted ring (a torus) using large circular electromagnets. The circular electromagnets produce the ring shaped plasma while a secondary magnetic field is produced by the plasma itself when a current is passed through it. This secondary field produces a helical twist in the magnetic field lines which is critical to the confinement of the plasma ring as it helps to prevent 'kinking'. This is a form of instability which can reduce the plasma density stopping the fusion process or even breach confinement.

Group Photo of students that took part in the Culham Centre Trip

The designs for the JET fusion reactor were started in 1973 in order to study plasma behaviour in conditions and dimensions approaching those required in a fusion reactor. One of the main obstacles in designing a working nuclear fusion power plant is that most reactors are too small to be efficient enough to produce more power from the fusion reaction than required to heat the plasma and confine it. The JET project was a first step in designing larger reactors that were capable of generating power in short bursts. The vacuum vessel in which the plasma is generated and confined is able to support a plasma torus of 90 cubic metres with a minimum and maximum radii of 0.9 and 3 metres respectively. This larger plasma capacity allowed JET to achieve the world's first controlled release of fusion power in 1991 after a preliminary experiment using Deuterium/Tritium fuel mixture.

One of the main advantages to JET over other fusion reactors was its robust design allowing it to be upgraded and modified since its first set of plasma experiments in 1983. This has allowed it to continue to operate and run experiments when most other reactors have been decommissioned. Engineers working on JET developed a remote operating system for replacing components within the reactors vacuum vessel without the need for a manned operation. This development has been a vital step forward for future reactors such as ITER which will be running continuously and the exhaustion of critical components is a certainty. We were shown the remote handling control room after the tour of the reactor. In October 2009 the reactor was shut down for 15 months whilst extensive upgrades were carried out to further improve the performance and longevity of JET. The heating power was increased by 50% bringing the Neutral Beam Injector up to 34 MW and the diagnostics elements were upgraded to capture more than 18 GB of raw data per plasma 'pulse'. However, the most exciting and practical upgrade to the reactor was the replacing of the carbon based vacuum vessel components

IMPERIAL MATERIALS Est. 1851

Scale model of JET

Connor (front) and other trip participants

with Tungsten and Beryllium ones. This was done so that JET performed more in line with ITER's future design and so that the reactor can better handle Deuterium/Tritium plasmas which cause many problems with current engineering materials due to the release of high energy neutrons from the Tritium which will ironically be providing the power in commercial reactors.

It is for this reason; the research into radiation damage in engineering materials, that the Materials Research Centre was built. It was explained to us that nuclear reactors, whether traditional fission or fusion, are extreme environments that place a huge demand on the materials that construct them. They are subjected to intense heat, pressure, corrosion and radiation effects that damage these materials. There was perceived to be a gap in experimental facilities for radioactive samples between the level of Universities which can process samples around 50MBq safely and the National Nuclear Laboratory in Sellafield. As we were shown round the newly built section, we were told that the facility was soon to offer 'hot cells' and an instrument room which will provide safe and effective containment for analysing sample materials that have been irradiated with fast neutrons. We were allowed to use the mechanical controls that allowed you to manipulate samples within the cell all from the behind the safety of Steel and concrete as construction was not finished and no radioactive sources were present. When completed these cells will be able to hold sources with an activity as high as 3.5TBq.

Neutron irradiation has several damaging effects such as neutron embrittlement, the Wigner effect and neutron induced swelling – all of which can lead to the failure of components. The high energy neutrons (25 eV and above) have enough energy to displace atoms from their preferred lattice sites through collisions. This action can lead to the creation of substitution and vacancy defects which leads to increased strength but a lower toughness. Wigner energy can be build up within the material when a large enough number of Frenkel defects (an interstitial atom and its associated vacancy) have been formed. Due to being in non-ideal lattice sites these defects have an associated energy and if enough interstitials have been formed they pose a risk of all releasing the energy at once creating a very large and rapid spike in temperature of the material. All of these effects can now be researched and analysed safely thanks to the introduction of hot cells within this research centre.

Hopefully this state of the art facility can help pave the way for a new generation of fusion reactors and bring about a revolution in power generation.

UROP:

Fabrication of Thin Film Indium Oxide Devices

Nick Twyman, a third year student, completed a UROP over the Summer break. He discusses the research he was involved in and explains how he personally benefited from the UROP.

I decided early in second year that I would like to do something productive over summer, however, I was very uncertain which area of industry/ research to pursue. I half-heartedly applied to one or two internship schemes, in a diverse range of areas, but had no real drive at such an early point to commit myself to finding a placement. During Spring term however, I found myself becoming increasingly interested in the "electronic devices" lecture course and so began to consider the UROP program. I realised the scheme was the perfect way to gain insight into the work of a PhD student, whilst also learning more about a field I was fascinated by. The time frame was flexible and fitted around my travel plans for summer. Despite applying rather late, the application process was straight forward and with the help of my supervisor, **Dr Anna Regoutz**, only took a few hours.

For the majority of the placement I was working in Blackett's physics laboratories fabricating thin film indium oxide devices, alongside a colleague of Dr Regoutz's. The goal of the project was to improve upon conventional annealing techniques used upon solution processed indium oxide devices. In order to fully convert indium oxide's precursor solution, samples have to be heated to approximately 250 °C on a hot plate; this is an extremely cost ineffective and slow process. The alternative method investigated involved sputtering a thin metallisation layer of a high absorbance chromium beneath the precursor layer and using a flash lamp to convert the film. The high energy photons emitted from the flash lamp were absorbed by the thin chromium layer causing it to rise to temperatures far exceeding 250 °C, directly heating the precursor and minimising thermal strain on the substrate. This rapid method allowed significantly less energy to be used during processing whilst also bettering patterning of the samples, making it ideal for industrial roll-to-roll processing of thin film transistors. Perhaps the most interesting feature of this technique, however, is its success with plastic substrates. As previously mentioned the thin metallisation layer minimises thermal strain on the substrate whilst also generating sufficient heat for conversion. This means that flexible polymeric substrates with relatively low melting temperatures can be used, opening a range of possibilities for flexible electronic devices such as displays. Consumer screens which you can fold and unfold may be closer than previously thought! The films were finally analysed using X-ray Photoelectron Spectroscopy (XPS) to find the degree of conversion and present results in a reasonable format.

In the final week I was asked to begin writing up a scientific research paper on our findings for publishing. This is of course a very long procedure and will undoubtedly continue into term time but it has finally given me an opportunity to use skills learnt and developed completing lab reports.

Overall the experience was extremely interesting and, in my opinion, invaluable to individuals considering a PhD.

IMPERIAL MATERIALS Est. 1851

Investigating Industry:

Visit to Airbus Filton

Zack Jeanrenaud, MatSoc's Junior Treasurer and second year student, reviews a MatSoc organised trip to the Airbus site at Filton in November 2017.

On the 9th of November, MatSoc organised a trip to send twenty keen students around Airbus' site in Filton. Everything was planned, we were to take the coach there and once on site, we would be given presentations and shown the work conducted at airbus, notably on the wings, landing gear and a virtual reality suite.

We had arranged for the coach to leave at 10 o'clock, so when everyone was present we made our way to Beit quad to wait for the coach. Around ten, we decide to call the driver to make sure he was on track, only to find the number that was given to us didn't exist…

Slightly worried, we call the coach company, they assure us they were in contact with our driver a mere thirty minutes earlier and that he should be there soon. Time is gently passing and still no news of the driver (who had visibly gone AWOL), so the coach company sent us a new one who arrived within ten minutes. And finally, we were off, only 45 minutes late.

Upon arrival, we were greeted with visitors' passes and a stern warning not to snapchat Airbus' intellectual property. Afterwards, a member of the graduate scheme gave a presentation about the company highlighting Airbus' path since it's foundation in 1970, from the conception of their first commercial aircraft, to the present day, with giants such as the A380 and their space and defence divisions.

> ***"It was a fantastic way to see how aerospace technology has evolved in recent years, and how Materials Science could play a part in future development"***
>
> ***-3rd year Materials student***

Due to our lack of coach driver and punctuality, we wouldn't be able to see everything as planned. Instead, we were split into two groups: one would see the virtual reality suite then the landing gear testing facility, the other would see the landing gear then wing testing.

My group was left in the safe hands of another graduate scheme member who escorted us to the landing gear testing facility. Before entering the warehouse, our guide showed us a decommissioned piece of landing gear, explaining the structure and drawing our attention to its most important part: a fail-safe "handle". A mechanical claw holds it in place and in case of an electrical failure, the claw would drop the landing gear which would fall into position under its own weight. This showed us how important planning for failure is in the aeronautics industry. Indeed, every simulation they run is using the same systems that are present in the planes, designed to be as realistic as possible and to consider every possible failure.

Airbus Filton-One of the few photographs students were permitted to take

Thus, their main concern was with fatigue, the bane of the industry. Loading and unloading tests were run routinely on landing gear and parts of the wings, subjecting them to cyclic stresses to grasp exactly the lifespan of each component: we even saw a test than had running since 2015 and was scheduled to end in early 2018. The testing areas themselves, left us in awe due to the sheer scale of the operations, with tensile testing machines that dwarfed those in G11 labs, canons that fire debris at wings and apparatus used to break an entire wing housed in a building several stories tall!

> ***"The day was great because we got to learn about lots of different tests Airbus run on different parts of the aircraft. We've learnt about some of them in lectures so it was really exciting to see them in real life!"***
>
> ***-4th year Materials student***

Finally, we returned to the conference room where the graduate scheme was presented. A member in his final months of the scheme shared his experience, going over the opportunities found in the two years he'd spent there. The company provides the chance to work in all the different areas of the creation of the aircrafts so the graduates can find their calling within Airbus and pursue a career there.

> ***"As a first visit to a manufacturing site, it was amazing to see the scale of production!"***
>
> ***-1st year Materials student***

Despite the slight mishap with the coach company, the visit was a remarkable success, giving each of us insight into the world of aeronautics and giving plenty of information as to the career opportunities at Airbus.

IMPERIAL MATERIALS Est. 1851

IMPERIAL MATERIALS

Est. 1851

Contact Information

Imperial Materials Society (MatSoc)

Royal School of Mines, Imperial College London,

South Kensington Campus, Kensington, London, SW7 2AZ

E-mail: materialssoc@imperial.ac.uk

Website: www.union.ic.ac.uk/rsm/matsoc/

Editor:

Amy Louise Tall

MatSoc Magazine Officer

E-mail: amy.tall16@imperial.ac.uk