

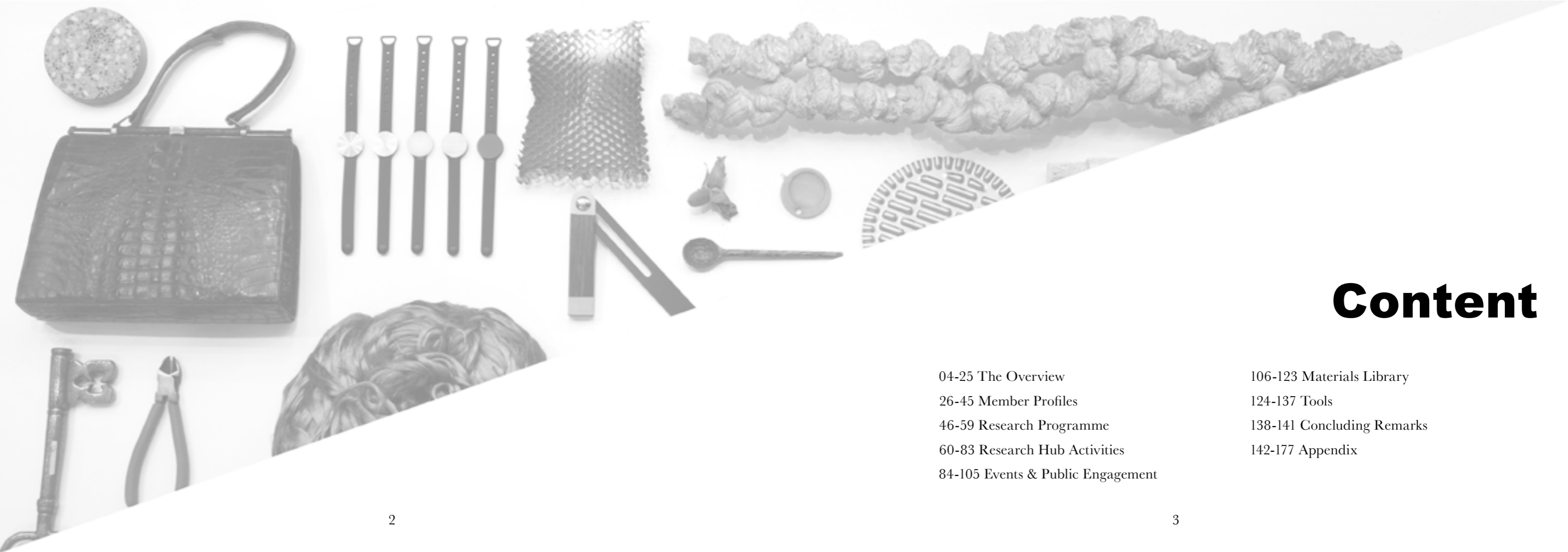


Institute of Making



Second Year Report

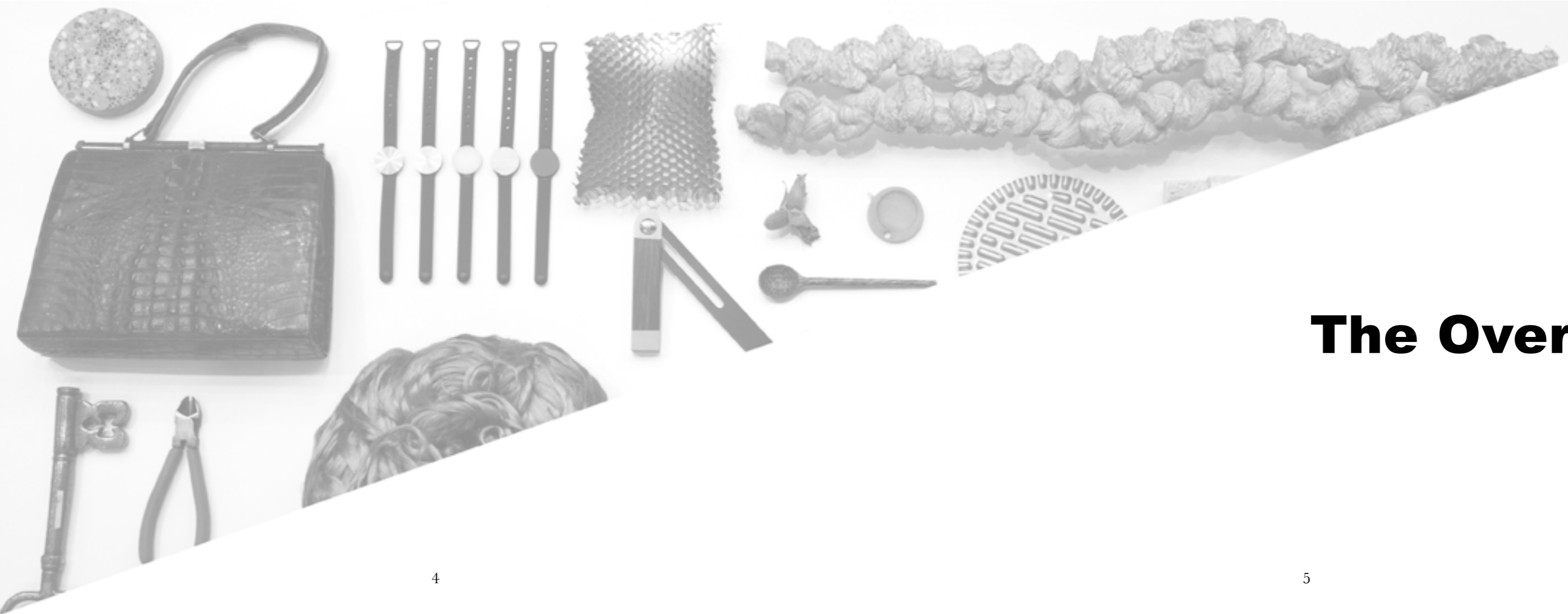
Institute of Making, UCL 2014-15



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The Overview

Why we do what we do...

“I love the fact the Institute is a place of fusion – you would never normally find this at a university in my experience – it draws all the right people and resources together to create a fluent environment with everything you need to progress both your academic projects and your personal horizons. That is the genius of it. It stretches you, it supports you and provides a bit of enlightenment.”
(Mark Ransley, CoMPLEX PhD Student)



We are a very unusual research club...

The Institute of Making is a place that encourages play, research and development through making. We have created a vibrant multidisciplinary community whose activities support the teaching and research communities within UCL, as well as anyone who is curious about stuff. We provide a fully equipped workshop, technical training, a library of materials and most importantly, inspiration and support.



Membership is open to anyone at UCL...

We currently have 4479 members, of whom 22% are staff and 78% are students. A further breakdown of the member demographic is as follows: female (46%), male (47%), no gender declaration (7%); undergraduates (42%), postgraduates (36%), academic staff (13%), professional services staff (7%) and other (2%). The membership encompasses a wide range of specialisms and interests from Art to Anthropology, Chemistry to Architecture, and Engineering to English Literature. 574 members have graduated or left UCL.



Doing is a different way of thinking...

A typical snapshot of activity at the Institute is as follows: two post-docs use the laser cutter to create some lenses for their optical experiments in Electronic & Electrical Engineering; an Architecture PhD student makes a wedding ring for her fiancée; a Professional Services staff member attends a masterclass on electronics; a Medical Physics undergraduate spends the day using our Materials Library to do research for their summer project; our technicians help some Slade students to use the 3D scanners and printers; a one day research workshop on the Hidden History of Things gathers together researchers from across UCL and around the UK.



We specialise in multidisciplinary materials research...

The Institute of Making acts as a research hub, bringing together and supporting interdisciplinary teams of researchers both at UCL and beyond. This year we completed a Bridging The Gaps grant (EPSRC EP/I00159X/2) that focused on encouraging and developing interdisciplinary projects across the university using a number of different methods, including seed funding for pilot research projects, summer studentships, and materials and making-focused research events. Our in-house prototyping knowledge and facilities have made us ideal collaborators for a number of successful multidisciplinary research projects, and as a result we are co-investigators for the Scrambled Messages project led by Professor Caroline Arscott at the Courtauld (AHRC EP/K038656/1), the Wearable Assistive Materials project led by Professor Nick Tyler (EPSRC EP/K020323/1) and partners in the new Centre for Nature Inspired Engineering led by Professor Marc-Olivier Coppens (EPSRC EP/K038656/1).



Our events often get fully booked in seconds...

Our events programme aims to do several things: to inspire our members and the public with regard to all things materials and making, to place us at the heart of the international making community, to introduce our members to new areas of interest, to help them acquire new skills, engage with experts in various fields of materials and making research, and gather together research collaborators.

Last year we held 69 events: 32 masterclasses (for example Soap Making, 3D Scanning and Millinery), 1 talk (The History of Robots), 2 factory visits (Closed Loop Recycling and the Ford Factory), 15 research events (Arts Meet Pyrotechnics, Health, Safety & Creativity and Materials & Society, for example), 4 Materials Library evenings, 4 corporate events, 3 outreach events, 1 Festival of Stuff and 3 public open days (Carbon, Robots and Metals) with a total attendance of approximately 5000, including a high representation from families and children.



We have one of the most wondrous collections of stuff...

The Materials Library is a collection of some of the most wondrous materials on earth, gathered from sheds, labs, grottoes and repositories around the world. It is a resource, laboratory, studio, and playground for the curious and material-minded to conduct hands-on research through interdisciplinary inquiry and innovation. The Materials Library Collection is currently comprised of over 2,000 materials. This year we launched the Materials Library App, designed to function as a tool that enables library users to navigate the physical collection, as well as a virtual repository of material knowledge.



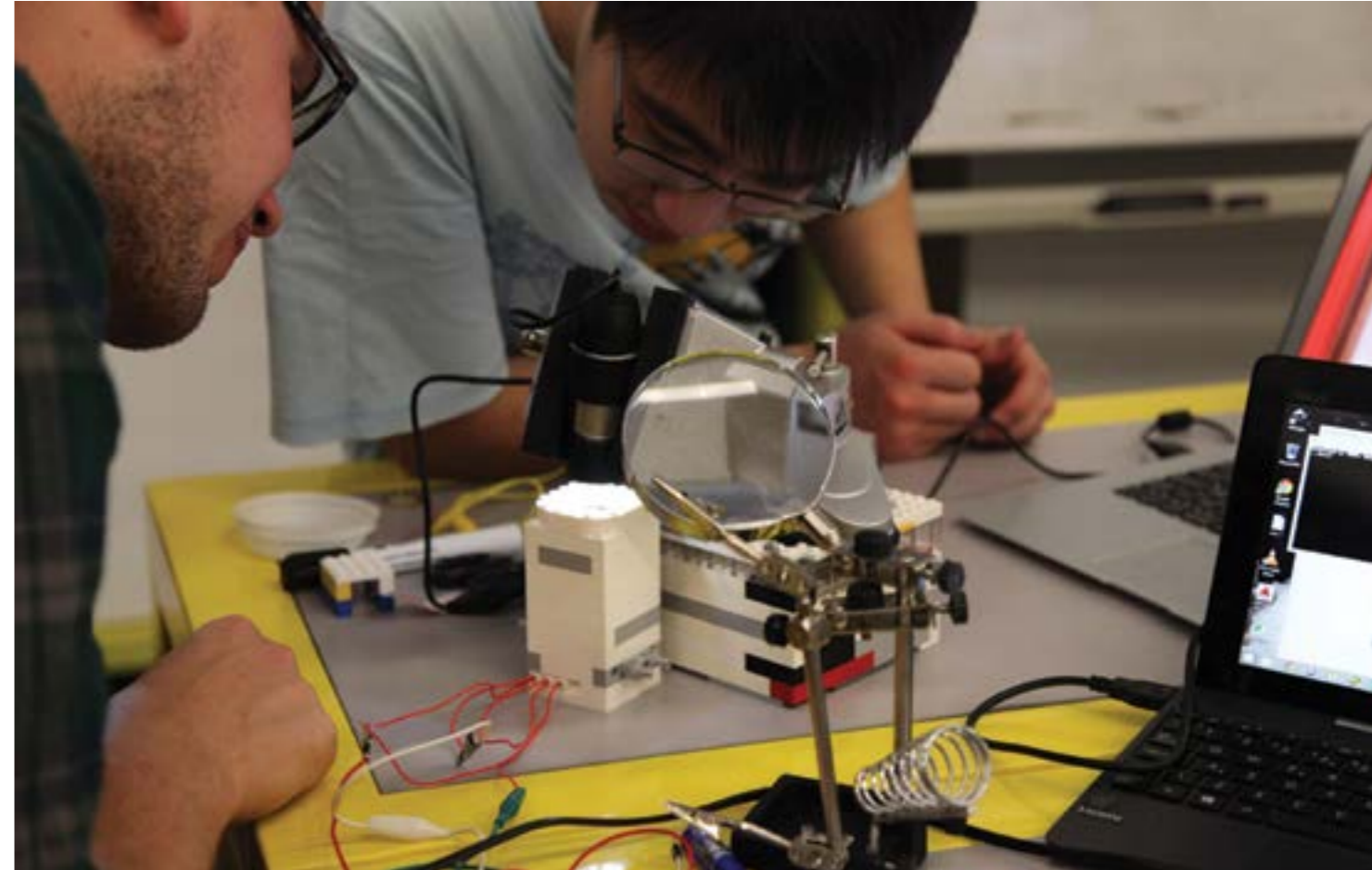
We have a public profile...

The Institute of Making and its team have gained a public profile as champions of making and materials, promoting them through social media (eg. Web, Twitter, Facebook), many newspaper articles (eg. The Observer, The Times, Wired Magazine) and TV and radio programmes (eg. BBC2's Newsnight, BBC4's Sky At Night, BBC Radio 4's Food Programme and The Today Programme).



We are international...

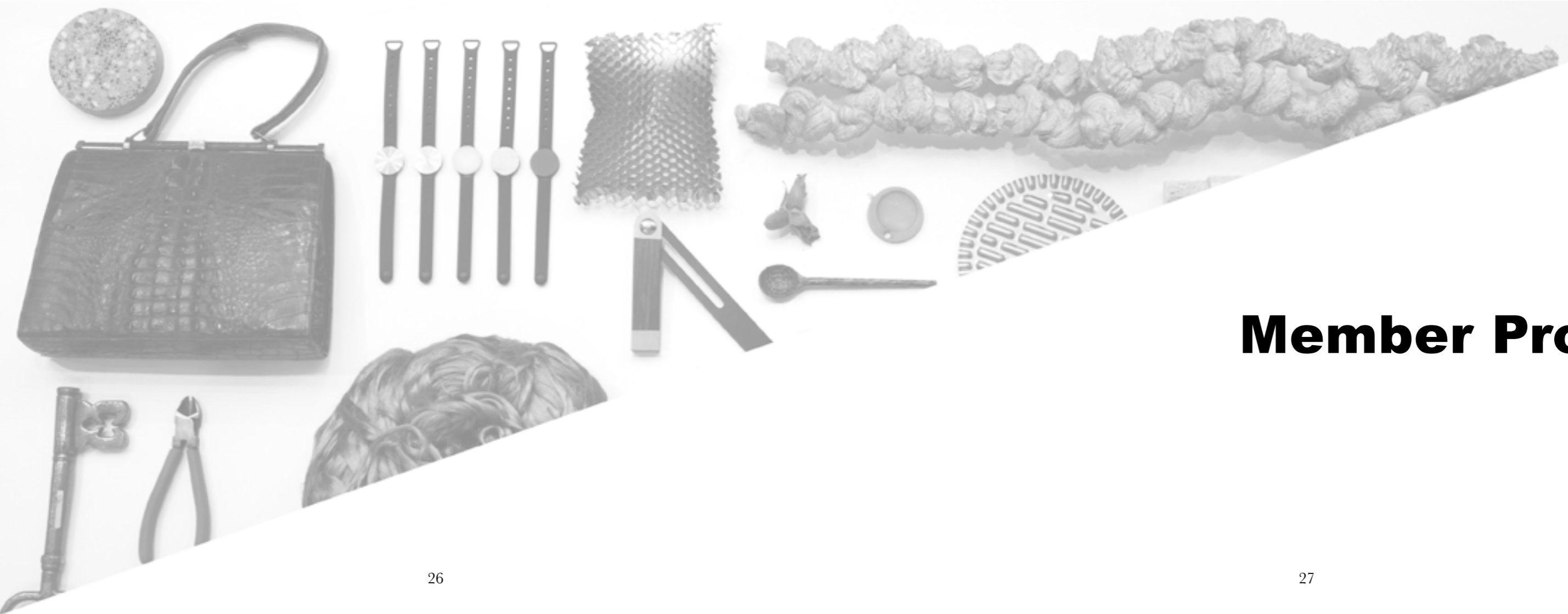
The Institute of Making has an international reputation; we have given invited talks all around the world from Beijing to Barcelona on our interdisciplinary materials research and our other activities, including building a multidisciplinary research environment centred on making. We regularly have visits from international research organisations, universities and companies who want to start something similar.



We do commercial & policy stuff...

Our profile has allowed us to influence policy makers and the national academies, attract industrial collaborators (eg. ARUP, ARM, ATKINS, Royal Academy of Engineering, Crafts Council), and inspire both current and future students and staff. We have had numerous visits from other institutions that wish to collaborate and many of these relationships are being actively developed.





Member Profiles

“*The Institute of Making is totally unique. One of the best things about it is that the staff really try to teach you – they are willing to spend time with you and look at other ideas and techniques. They have the time to engage with you. It’s a true learning space. Here, we are given the freedom to make crazy stuff and experiment with decent tools.*”

(Wiktor Kidziak, Bartlett School of Architecture)

We currently have 4479 members, of whom 2590 are fully inducted and have day-to-day access to the space. 22% are staff and 78% are students. A further breakdown of the member demographic is as follows: female (46%), male (47%), no gender declaration (7%); undergraduates (42%), postgraduates (36%), academic staff (13%), professional services staff (7%) and other (2%). The membership encompasses a wide range of specialisms and interests from Art to Anthropology, Chemistry to Architecture, and Engineering to English Literature. 574 members have graduated or left UCL.

This last year has exceeded our expectations in terms of numbers of new members, as well as their willingness and enthusiasm to contribute to the atmosphere of collaboration, courtesy and enquiry. Although we have broken down the numbers in terms of staff and students there is no hierarchy in the workshop: everyone is welcome and treated equally, be they a professor or a librarian, a fledgling first year or a seasoned PhD student.

Maker groups and new projects have begun to spring up without prompting from us, and the users are taking the initiative in running teaching sessions of their own. A sense of natural cooperation, shared ambition and cross-disciplinary comradeship has arisen without a feeling of competitiveness.



We offer materials bursaries for the student members (through the support of alumni donors) precisely because we want to encourage experimentation and practical learning unfettered by the limitations of the cost of materials. Access to the equipment is still free for all (although we do charge basic material costs for repeated use of the most expensive processes). At its best, the Institute continues to be a place where people help each other, teach each other and inspire each other.

Our Member Project blog has become an exciting window into day-to-day activities in the space: www.instituteofmaking.tumblr.com

Wiktor Kidziak MArch Architecture

“Material understanding is super important in architecture. Despite this age of beautiful digital renders, we need materiality: it’s the future – that’s where innovation happens, and will make buildings more environmentally appropriate.”

Wiktor has been making ceramics using slip cast terracotta to make hollow objects; lightweight, interlocking architectural models.

The ceramic body is interesting to him as it has different properties at different temperatures. It works as a cooling façade, sucking moisture at night, evaporating and cooling by day. When terracotta is fired at a higher temperature it becomes darker red, stronger in compression and more efficient; you can tell the structural strength from the shades and gradations of the clay. Some people show structural properties in models through colour, using 3D printed plastics, but with ceramic it seems more holistic to him.

Wiktor likes that by just being in the Institute of Making you find out things about materials. In watching other members pouring pewter he was inspired to begin investigating integrated electrical systems in architectural components.

In the future he would like to be a member mentor, giving classes about what he has been making, which would be useful to both sides. *“It is great to learn from other members – there’s lots of expertise at UCL”*. He wants to continue to meet people from other disciplines through making.



Dr Dafne Zuleima Morgado Ramirez
Research Associate, Institute of Orthopaedics

“The expertise here has been vital. Real world research projects in my field rely on having the confidence to learn to make stuff yourself and continue to improve, knowing you can ask for advice or reassurance that you’re doing the right thing.”

Dafne is a biomedical engineer who has been making force sensors and elongation/ bending sensors that can be worn comfortably against the skin as part of our Wearable Assistive Materials project (see page 52). These attach to the replica human hands and finger joints she has made to replace existing anatomy models, which do not adequately simulate the feel or movements of real hands. She has used silicone grease to mimic moving joints, attached them to the sensors with silicone rubber, and covered it in a realistic, softer silicone skin. She has learnt a huge amount about the material as a result, like how to perfect the silicone in the vacuum degassing chamber before casting and which chemicals to use to modify stiffness, as well as some hard lessons about the compatibility of different silicones and the art of asking the right questions to avoid expensive mistakes.

Dafne feels she could not have done this project without the Institute of Making. Her manager is an orthopaedic surgeon with a different set of skills. There would be a far longer and more expensive period of trial and error, and her research budget would have had to cover specialist tools and a place to keep them. She has had lots of conversations about her work with other curious members, and has been encouraged by people who have used the 3D printer in interesting ways, seeing the possibilities for her own project.



Daniel Black **BSc Geography**

“Here exists a melting pot of knowledge. Anyone from UCL can come in and there are really nice natural interactions between staff and students. Everyone is equal and you never know what you will find or who you will meet when you walk through the door, but it is guaranteed to be interesting.”

Daniel’s expertise in watchmaking led to his involvement in a project to advance understanding of the Antikithera mechanism (an ancient Greek astronomical calculating machine) through physical models. The project was supported by our Summer Studentship scheme and is in partnership with Geography and Engineering’s 3DIMPact research group. Daniel has been recreating the cogs, gears and arbors from archaeological evidence, using the 3D printer and laser cutter. The team would like to use this proof of concept to continue at PhD level.

Other eye-catching projects he has undertaken include the making and experimental testing of high-powered lasers. He now holds the Guinness World Record for balloons popped in one minute, assisted by James Mould, who used our Materials Bursary to create a mathematically-arranged helium balloon display. We also assisted Daniel’s attempt to create the world’s largest laser cutter with our 10 tonne gantry crane. Daniel has used most of the tools here over the course of the year, through formal and fun projects. As a result of being here, Daniel has been introduced to staff at the companies Selex and British Aerospace (BAE), with whom he starts paid internships over the summer.



Zuzana Pincikova & Gabriela Hujova UCL Librarian and MA Text and Performance Student

“It’s so exciting that there exists a space with all the materials you could imagine, and technicians who are happy to help you with using them. People who aren’t using it at UCL are missing out! I can imagine Materials Libraries and Makespaces being a feature in universities of the future for everyone to use alongside their more traditional libraries.”

Zuzana and Gabriela have worked together on many creative projects, including propmaking for Gabi’s new play about robots. They decided to make and enter their own robot in the Institute of Making’s Great Egg Race (see page 98), having never worked with electronics before. Zuzana learnt Arduino and animatronics at our masterclasses, and their robot came a triumphant second in the race!

Zuzana has learnt lots of new skills in the Makerspace. She has tried hand-building with clay, plaster mould profiling, casting and raku firing and used the sewing machine to sew costumes for Gabi’s play. She also learnt soldering and electronics, and they did lots of research on how to make circuits using conductive ink and graphite. All the knowledge they gained from participating in the Robot Race was brand new and Zuzana has since been inspired to join the student-led Robotics Society, founded at the Egg Race.

Zuzana also got involved in Hilary Powell’s Pop Up Pop Up, one of our Small Research Grant funded projects (see page 74), bookbinding and assembling the pop up books. These new skills complement her professional interests as a librarian, and she cannot wait to use them.



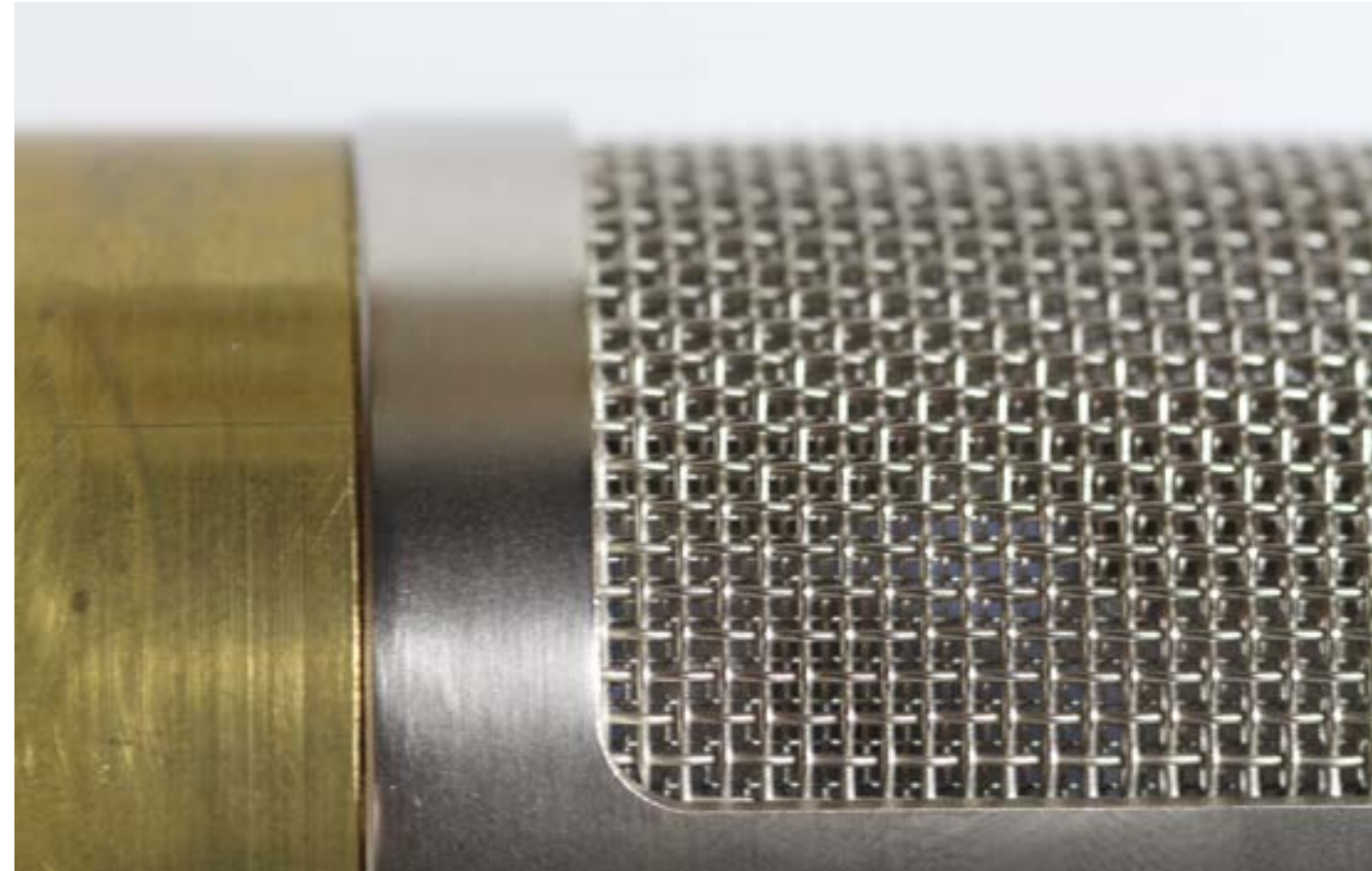
Jack Reynolds

MEng Electronic Engineering

“I’ve really benefitted from working with other members. It’s very handy that PhD physicists are hanging around, for example. It’s fun to share things when you normally work alone: you end up chatting away to lots of very bright people from all disciplines making unusual things.”

Jack is building a studio microphone using 1920s German precision techniques, which produce superior sound quality. This was a side project that has only become a reality because of the Institute of Making: he has learnt how to do practical electronics, as what he is studying is largely quantum physics and theory-based. He has been investigating point-to-point wiring: a different way of making a circuit to the usual printed circuits boards. He has learnt CAD and graphics software to 3D print and laser cut his own parts, in order to get them made commercially. He has also brushed up on all the maths that goes with making things. The microphone’s sound capsule uses gold-coated mylar, 5 microns thick. He has been going over to the London Centre for Nanotechnology to learn how to do vapour deposition – the Institute of Making has formed links to several other making facilities at UCL to share tools and expertise. He has gleaned a lot from watching the way that 3D printable materials behave when worked, and has laser cut sorbathane and cast rubber for their anti-vibration properties.

He has since won UCL Advances Entrepreneurathon worth £10,000 to set up a new company, Reynolds Microphones, which, he notes, is exactly what he came to UCL for. All these resources mean he can make the microphone entirely himself so is able to make sure a very high quality product goes into production this summer.



David Dutko BASc Arts & Sciences

“Nothing prepared me for the moment it (the ceramic piece) came out of the kiln. Having never done anything like this before, I couldn’t imagine its physicality - it is magic, more than the sum of its parts. You spend so much time with each process, making every detail, it creates an incredible intimacy.”

David has been making several gaiwan, lidded bowls traditionally used for infusing and drinking Chinese tea, and had to learn all the skills from scratch. He initially wanted to 3D print the design and mould it but our technician Zac questioned the use of the printer and showed him how to form plaster by turning it on the wheel with a laser cut former. David then used the model to make a multiple part mould for clay slipcasting hollow forms, which was quite a learning curve. He expected to use porcelain but the texture was difficult and not as he imagined, so used softer clay. He then started glazing, with mixed success so far, using a satin black glaze.

David said he really got to understand the limitations and behaviour of each material: how the porcelain partially melts in the kiln and makes the saucer angle downward, how the glaze “crawls” if the piece is dusty or has fingerprints on it. He worked alongside Wiktor (see page 30) and they helped each other with slip casting, sharing tips and techniques. David feels making is undervalued - that most people get their stuff done elsewhere out of sight, out of mind, and miss the value of knowing how something is done. His experience here has really opened some doors for him. He said he was reluctant to listen to advice at first but has become more open minded. Zac has taught him that there is often more than one way to do things.



Andre Sacharow **BASc Arts & Sciences**

“In the Institute of Making I enjoy the feeling of openness – you don’t feel a sense of obligation for your work to be important or ‘good’ – you can make things from offcuts or recycled bits and that’s accepted, but they do teach you proper skills.”

Last summer Andre found himself sofa-surfing in London. Although he enjoyed communal living he found that he and his friends needed a refuge and started thinking about what sort of space could provide that. He decided to make himself a mobile house. He started with the one-square-metre-house designed by Laotian German guerilla designer Van Bo Le-Mentzel who releases plans for his designs free online. Andre feels that student halls disassociate people so wanted to make a space that attempted a more autonomous way of living with a sense of freedom. He thinks that projects like this can change the urban landscape, creating a community of private spaces that are connected, not isolated.

Andre has been getting a feel for the materiality and diversity of wood, researching and ordering, cutting it, learning its strengths and weaknesses and what it is like to build from a plan in a mini architectural project. For him, the great thing about the Institute of Making is the quality of the advice – Zac taught him to use 4 or 5 saws on the same piece of wood to gauge the effect.

The next iteration of the house will be more of an exercise in engineering; making it better and more environmentally resistant. This project has given him the confidence to plan projects, empowering him to ask the right questions and to learn more.



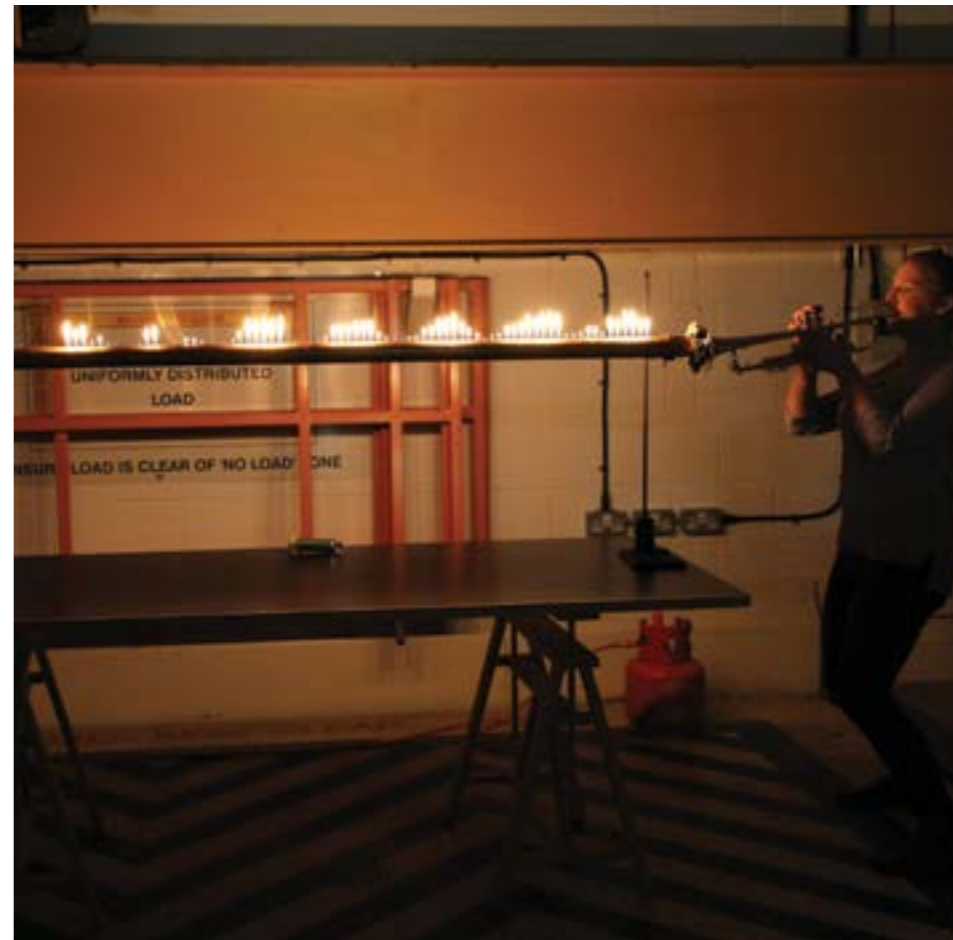
Anna Ploszajski Chemistry PhD Student

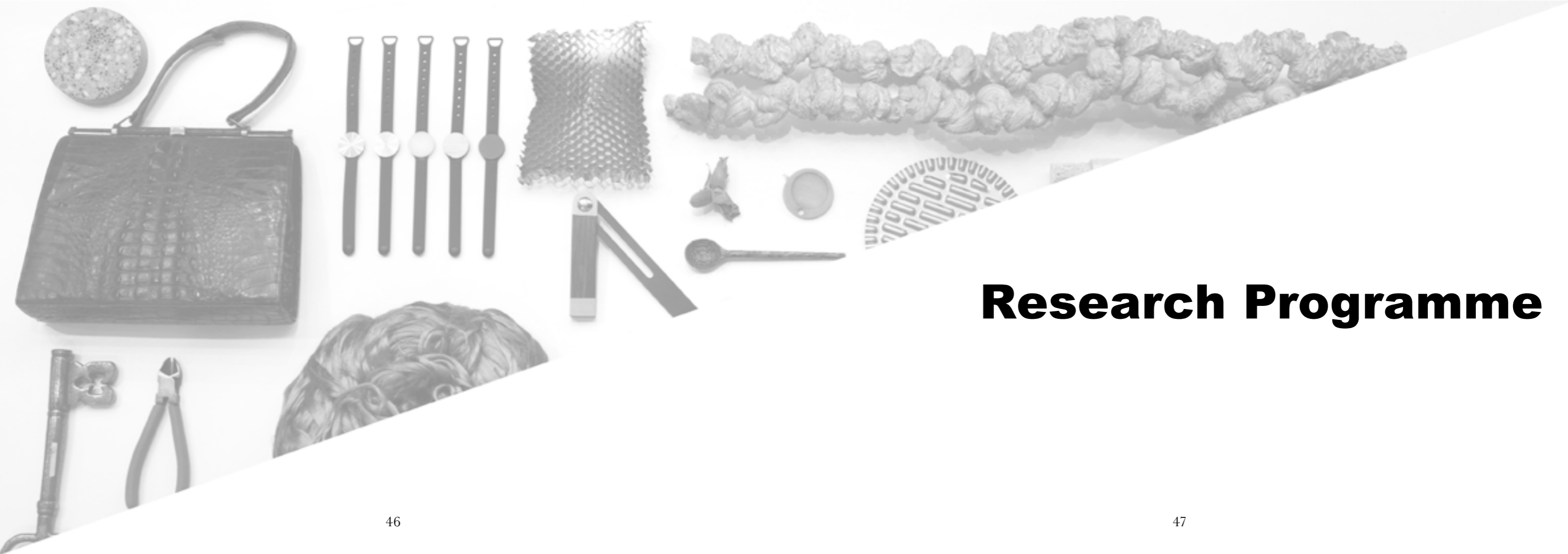
Anna made a Rubens' Tube as part of her demonstration kit for the Science Show-Off show at the Bloomsbury Theatre. A Rubens' Tube is a pipe with holes all along the top and a rubber membrane stretched over one end, which is filled with propane and lit like an elongated gas burner. Anna plays the trumpet, which is ideal for the job of generating sound waves, which then vibrate the rubber membrane and travel down the tube, becoming visible in the size and pattern of the flames.

Inspired by an online video, her first attempt at the tube was made from a plastic drainpipe and enabled her to quickly test out how possible it was to make it. The second version was made of copper – not perfect because of its thermal conductivity, but soft enough for a beginner to work with, and quite a beautiful thing in the end.

Jim from BOC helped her with the gas line and trained her in using and igniting the propane safely. They also modified the design together to give her more control on stage. She gained confidence learning from people who deeply understand how materials behave and who were friendly and encouraging.

New skills she learnt include drilling and brazing. She found it amazing how conductive copper is and how hot it got when sanded. She also learnt a lot about how to plan a making project. She is now interested in joining the Institute of Making's Experimental Orchestra, which will happen later this year, and getting involved with the Materials Library to explore the sound of materials.





Research Programme

The Institute of Making team undertakes its own research programme. We specialise in developing innovative multidisciplinary research methods and tools for exploring the many different facets of materials and making. These draw together approaches from materials science, design research and anthropological approaches, expressing knowledge gained through physical sets of objects and prototypes as well as through traditional academic publications. Our sensoriaesthetics research, for example, systematically explores the relationship between the physical properties of materials and subjective experiences of their sound, taste and feel. Through our involvement in the EU project Light.Touch.Matters (FP7-NMP-2012-SME-6) we are extending that approach to further investigate the cultural associations of materials, with studies focusing on perceived risk, sustainability and healthiness.

Our multidisciplinary team is composed of researchers and practitioners with a wide variety of academic perspectives and expertise. In combination with our in-house prototyping knowledge and facilities, this makes us ideal collaborators in a wide range of successful interdisciplinary projects. We are co-investigators on the Scrambled Messages project led by Professor Caroline Arscott at the Courtauld (AHRC EP/K038656/1), the Wearable Assistive Materials project led by Professor Nick Tyler (EPSRC EP/K020323/1) and partners in the new Centre for Nature Inspired Engineering led by Professor Marc-Olivier Coppens (EPSRC EP/K038656/1).

We are currently developing new collaborative research projects with a variety of partners on themes as varied as digital crafting; urban manufacturing for the 21st century; animate matter; the art of measuring; health and safety in small studio making practice; materials selection for hospital architecture and healthcare environments and socio-technical materials for prosthetics.



Light.Touch.Matters

EU FP7-NMP-2012-SME-6/310311

Light.Touch.Matters brings together material researchers, integration specialists, design researchers and product design SMEs from 9 countries and 17 different organisations. Flexible piezoelectric polymers are being combined with organic light-emitting diodes (OLEDs) in different ways to create products that contribute positively to healthcare and wellbeing. These new polymeric piezo and OLED stacks are flexible and formable, as well as being low energy and low cost. They can therefore be seamlessly integrated into a variety of consumer products, resulting in entire objects that respond to their users in new and exciting ways. Prototype products are now coming to life, with applications as varied as medical rehabilitation devices, automotive technologies, consumer electronics and sports wearables.

This project is particularly innovative because the development of these new materials is design-led. In order to make the most of the unique properties of these smart materials and influence their development as they emerge from the laboratory, designers need to be able to communicate effectively with materials scientists, and vice versa. As well as developing new materials and novel uses for them, the project team are building tools and methods to help designers and materials scientists work together successfully. The Institute of Making play a multi-faceted role in the project, working to enhance interdisciplinary dialogue, conducting research to explore users' experiences of the new materials and technologies involved, and disseminating the outputs of the project.

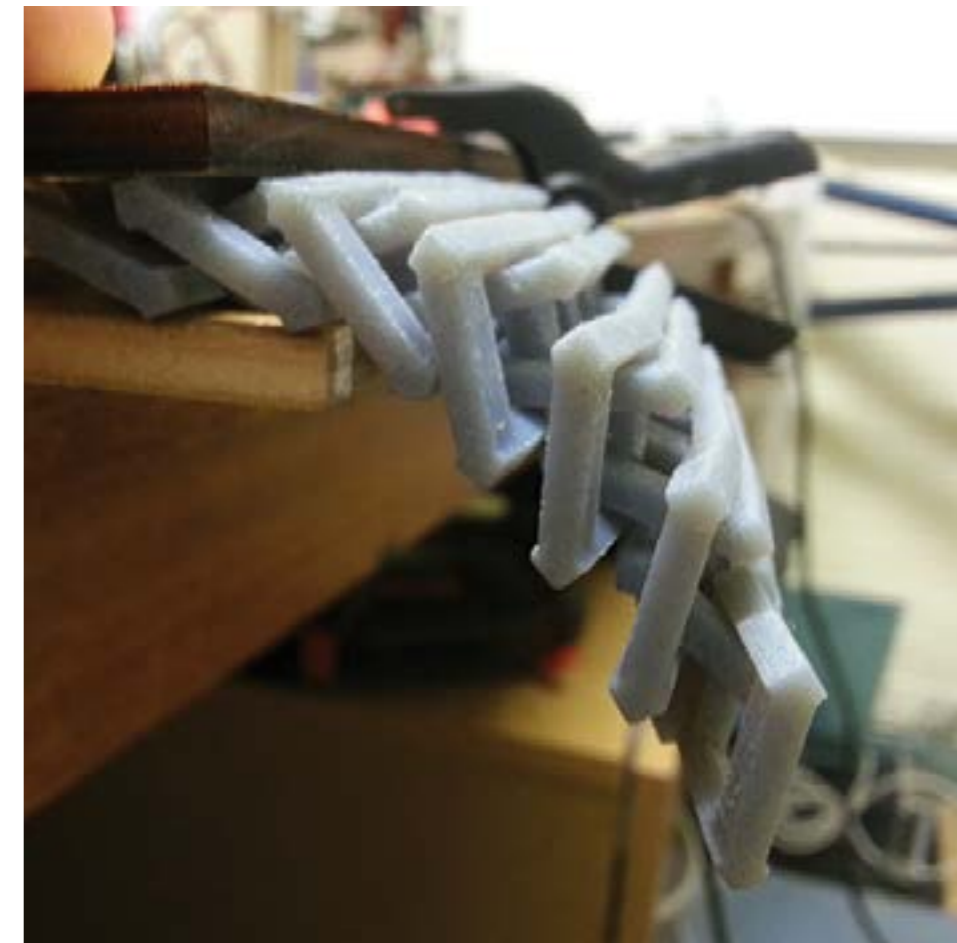
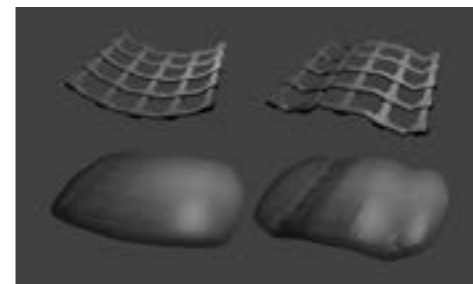
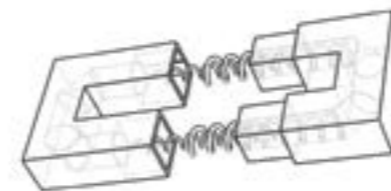
For more information: www.light-touch-matters-project.eu



Wearable Assistive Materials EPSRC EP/K020323/1

The Wearable Assistive Materials (WAM) project, led by Prof Nick Tyler in Civil Engineering, is developing a smart material capable of morphing between a rigid and flexible state. In the long term this material will be applied in the design of a lightweight and unobtrusive wearable exoskeleton to be used as a rehabilitation aid for a range of mobility disorders. This project is part of larger body of research that aims to make wheelchairs redundant for as many people as possible. Although the use of a wheelchair can enable a person to move around, this comes at a cost: there is a real problem with rotator cuff tears and other shoulder problems resulting from the continued work of self-propulsion. A wearable assistive material that can support walking without the need for motors, visible splints or other perceivable supports will allow people to enjoy life without having to think about accessibility for their wheelchair. This ambitious project requires a truly interdisciplinary approach: the team includes civil engineers, orthopaedic and musculo-skeletal scientists, clinicians, biomedical engineers and materials scientists. For example, PhD Student Mark Ransley, whose images feature opposite, has made his own 3D printer to create an actuating chainmail structure. He has also created a digital modelling platform to allow the simulation of this new class of wearable assistive materials. A clear impact so far has been the awarding of further EPSRC funding to another research consortium seeking to build on our work (EP/M025977/1).

For more information: www.instituteofmaking.org.uk/research/wearable-assistive-materials

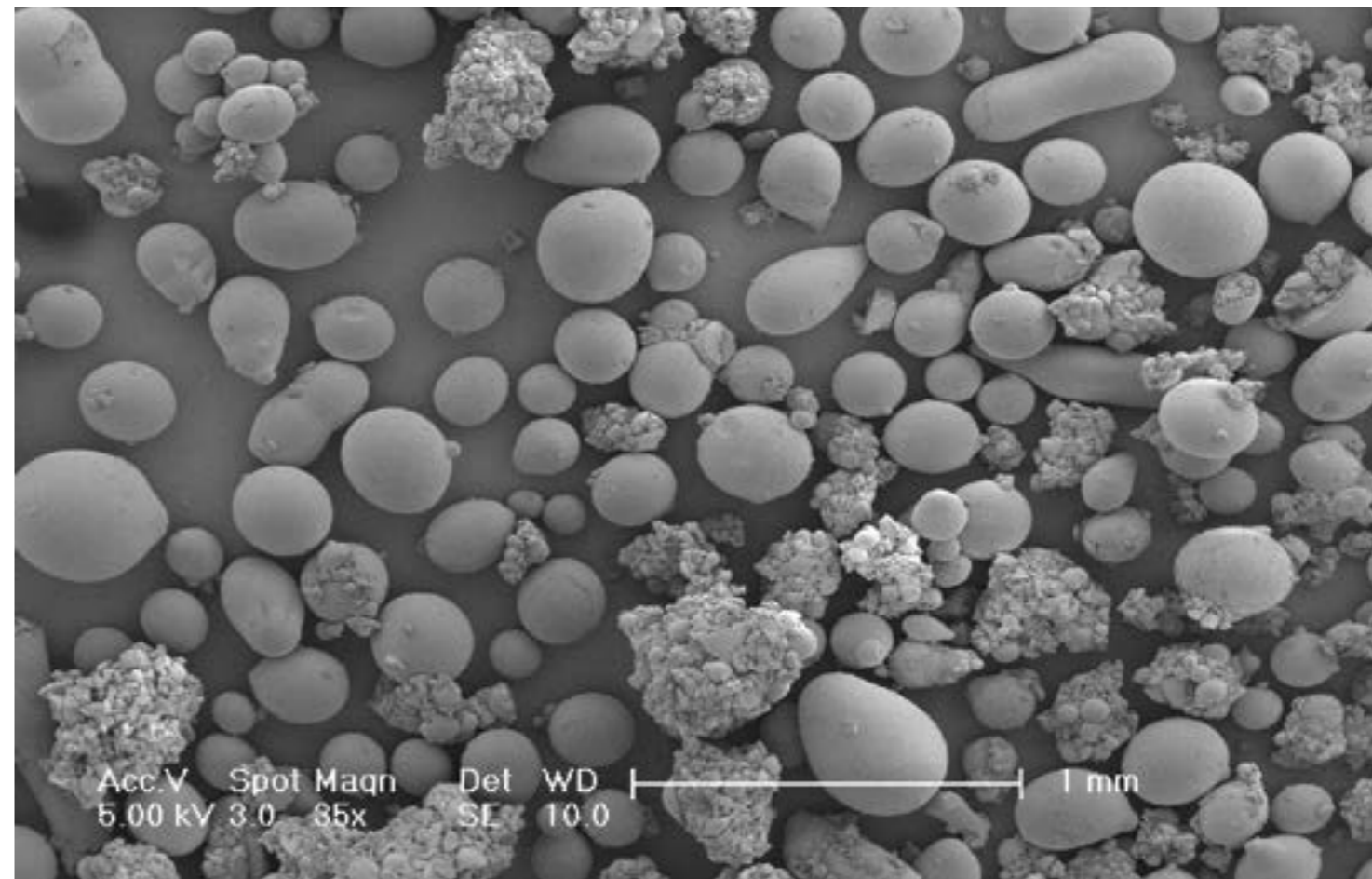


Nature Inspired Materials

EPSRC EP/K038656/1

The Centre for Nature Inspired Engineering, led by Prof Marc-Olivier Coppens in Chemical Engineering, draws lessons from nature to engineer innovative solutions to our grand challenges in energy, water, materials, health, and living space. Researchers at the Centre aim to uncover the fundamental mechanisms underlying desirable natural systems traits and apply these mechanisms to the design and synthesis of man-made systems. The work of the Centre's 20 academics, 7 post-docs and 5 PhD students focuses on three nature-inspired core themes: Hierarchical Transport Networks, Force Balancing and Dynamic Self-Organisation. Institute of Making Director Mark Miodownik is theme leader of the Dynamic Self-Organisation stream and works with postdoc researcher Dr Ayomi Perera on the development of a new class of bio-inspired, "agent-based" materials for use as nano-catalysts, drug-carriers and self-healing materials for industrial or medicinal use. Inspired by the mechanisms of growth and replication of bacterial colonies, Ayomi and other researchers in the Centre are developing materials that will have the potential to self-heal and self-organize in a dynamic and efficient manner, whilst also being robust and durable. The Institute of Making is a key research partner in this project, providing materials research and prototype construction. The Centre unites a highly interdisciplinary team of researchers from around UCL, with backgrounds as varied as genetics, computer science, chemical and materials engineering and architecture. It also acts as a hub for involving industrial partners and other researchers beyond UCL.

For more information: www.natureinspiredengineering.org.uk/the-centre



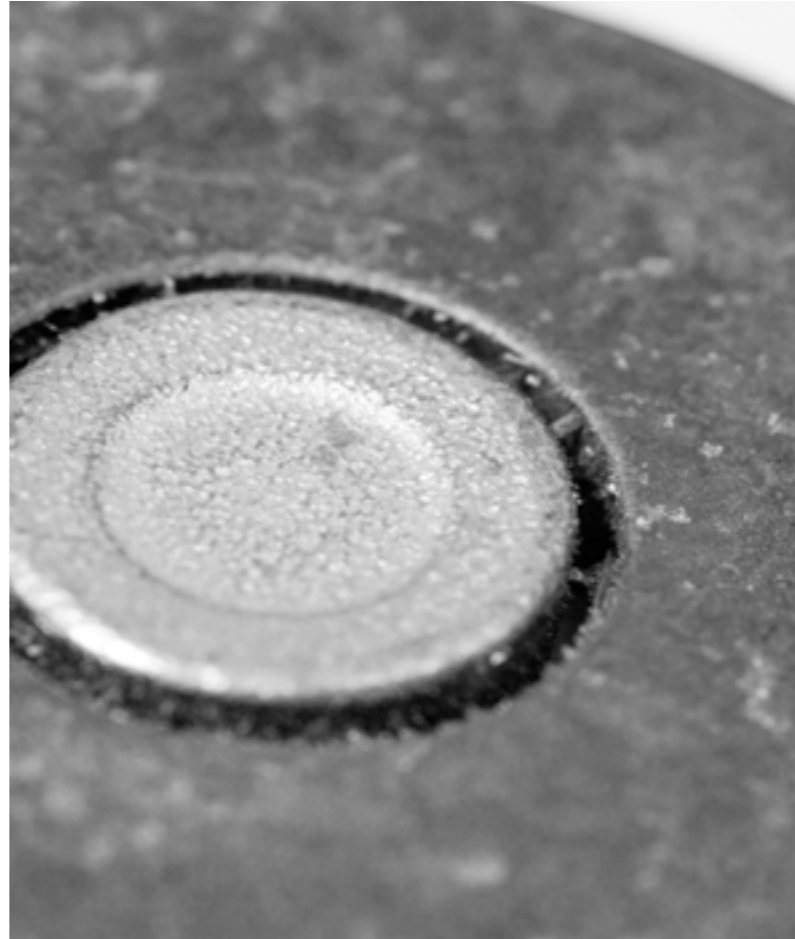
Scrambled Messages

AHRC EP/K038656/1

Between 1857 and 1866 the Victorian public's attention was caught by the drama of repeated attempts to lay a submarine cable across the Atlantic for the transmission of telegraphic messages. Much like the Internet, from the moment of its inception, the transatlantic telegraph became the focus of hyperbole, inspiring visions of perfect communication across vast distances. However, over subsequent decades it became apparent that this technology faced a range of technical constraints. Paradoxically, the telegraph was imagined as a perfect form of communication, whilst at the same time rendering up incomprehensible and damaged messages.

This project, led by Professor Caroline Arscott from the Courtauld and Professor Clare Pettitt from King's College London, explores the hypothesis that the 'scrambling' of telegraphic messages was as significant for Victorian culture as the sending of flawless messages. One year into the project, the team have been busy exploring the influence of telegraphic communication on artistic forms, material practices and sensory landscapes.

Historical and literary analyses examine how the emergence of this imperfect technology, with its encryption and one-message-at-a-time capability, influenced new cultural forms like the short story and Victorian imaginings of space, time and failure. Events designed to explore experiences of early telegraph cable-laying recreated the soundscapes and examined the logbooks of the cable-laying ships, explored historical details of practices of unwinding and rewinding cable, and practically engaged with splicing and net-mending through hands-on demonstrations.



The project pays close attention to the specifics of the materials, objects and technologies that were needed for scientific experimentation and the laying of the first transatlantic cable. Through an exploration of the crucial role played by rubber, gutta-percha, copper and hessian in the development of the telegraph, the Institute of Making contributes to a materially-grounded understanding of the impacts of the technology on the Victorian cultural imagination.

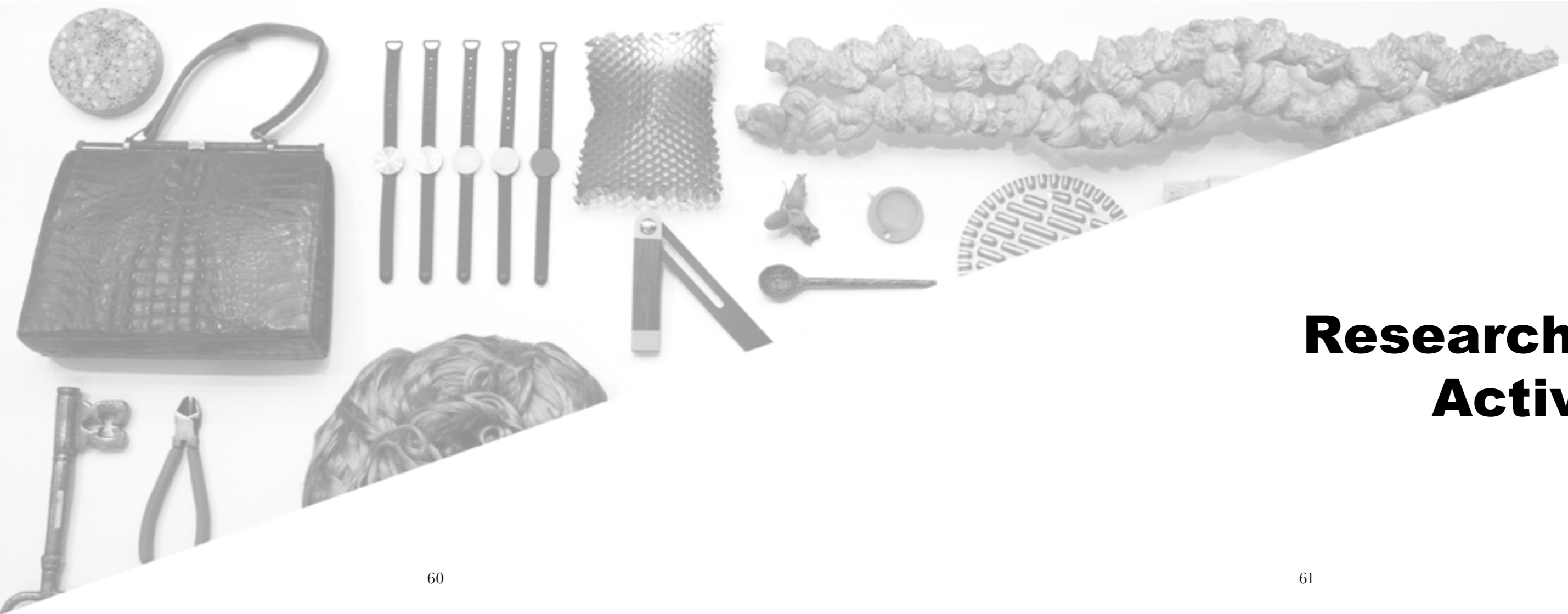
For more information: www.instituteofmaking.org.uk/research/scrambled-messages

Sensoaesthetic Materials

Over the last six years, the Institute of Making have been developing a sensoaesthetic theory of materials, systematically investigating the relationship between the measurable, physical properties of materials and peoples' subjective responses to their tactile, gustatory, somatosensory and acoustic qualities. A growing collection of specially made physical objects lie at the heart of this research, the purpose of which has always been three-fold: to systematically explore sensory, aesthetic and emotional experiences associated with particular materials, to translate these subjective experiences into a technical language materials researchers are more familiar with, and to convey the science of materials to the design community. Materials science tends to concern itself with the physical characterisation of materials, while artists and designers tend to focus primarily on the aesthetic side of materials. In developing a sensoaesthetic theory of materials we have tried to forge links between these two communities and improve our understanding of how people interact with materials, with the ultimate aim of changing the course of materials research, design and manufacturing, leading to more innovative, multisensory and emotionally-durable design. We are currently expanding this approach by combining the systematic, scientific study of materials with ethnographic research that tries to understand how particular preconceptions or anxieties about materials arise in specific cultural and historical contexts. We are exploring how this new combination of methods might allow us to further investigate the cultural associations of materials like perceived risk, sustainability and healthiness.

For more information: www.instituteofmaking.org.uk/research/sensoaesthetic-materials

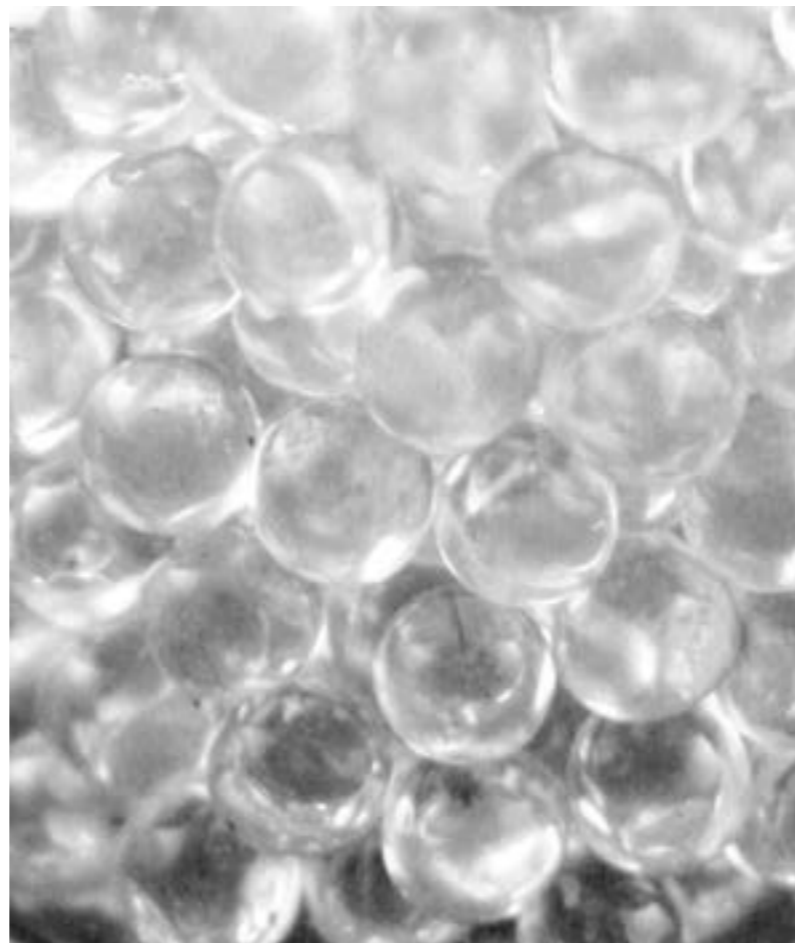




Research Hub Activities

As well as conducting our own research, the Institute of Making acts as a research hub, bringing together and supporting interdisciplinary teams of researchers both at UCL beyond. This year we completed a Bridging The Gaps grant (EPSRC EP/I00159X/2) that focused on encouraging and developing interdisciplinary projects across the university using a number of different methods, including seed funding for pilot research projects, summer studentships and materials and making-focused research events. The resulting 51 interdisciplinary research projects involved 141 researchers from 9 of the 10 UCL Faculties and 23 undergraduate and postgraduate students as named contributors, as well as countless other unnamed students involved in research and teaching crossover activities. These collaborations are too numerous to describe but we give a flavour of them in the following pages. One of the striking outcomes is that this hub model is very effective in providing early career researchers, such as post-docs and young lecturers, opportunities to collaborate and to develop new projects together. The Robot-Actuated Ceramic Casting and the Soprano projects described in this section are good examples of this. We also provide a research environment that allows projects that do not fit comfortably into any particular academic department, either for practical or intellectual reasons, such as the Dinner with Picasso and the Cleaning Materials projects described here.

We support interdisciplinary materials research through summer studentships, research events and the provision of advice and expertise. Our events are a combination of talks, conferences, discussion groups, demos and research-through-making sessions on a variety of themes like Materials & Society and Hidden Histories of Things. These events open up research opportunities to our members and to an audience outside UCL, inspiring people to explore new areas of interest, acquire new skills, engage with experts in various fields of materials research and making practice, and gather together research collaborators. Research teams are also formed



at the Institute through opportunities offered by other departments and institutions, such as the Material Histories seminar series, the LEGO2NANO project and the Material Storeys collaboration. This section describes some of these interactions.

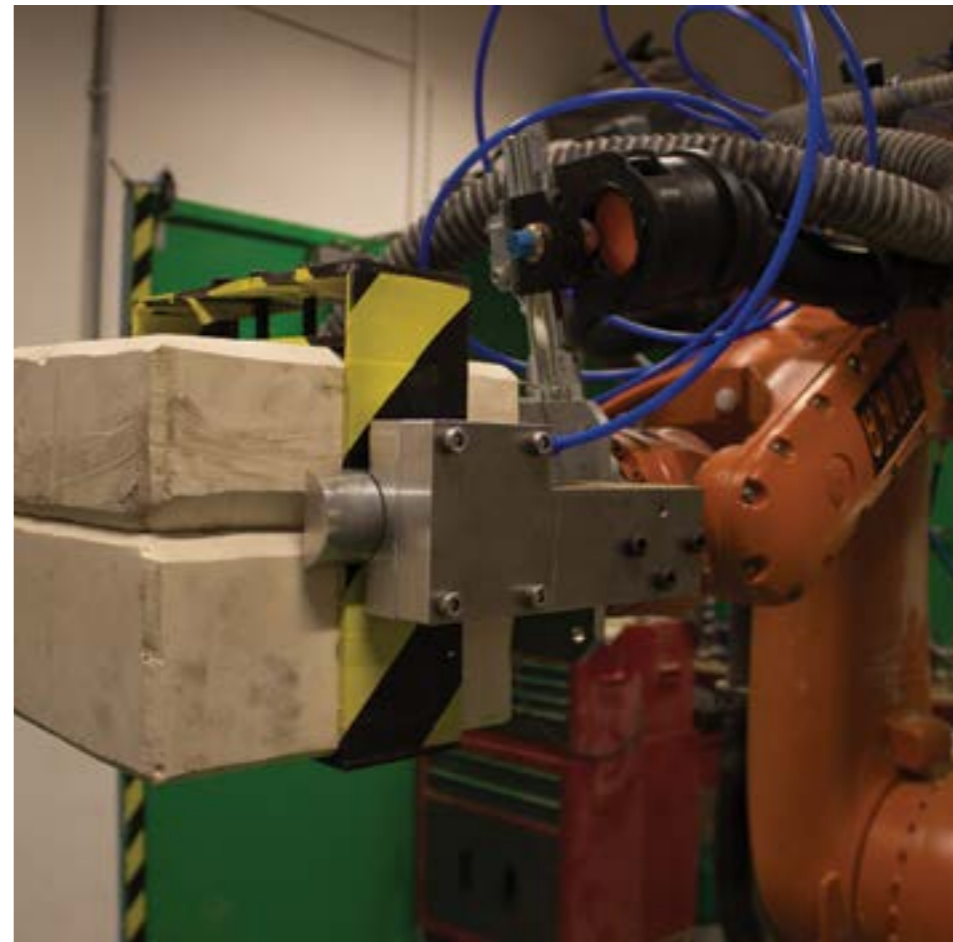
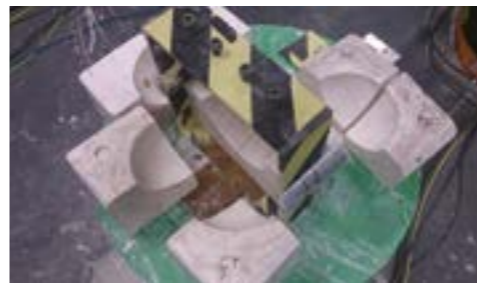
Because the Institute gives equal status and access to students and staff alike, we have been remarkably successful in embedding undergraduates into the ethos and practice of research. The Makespace and Materials Library are not bookable spaces, and because we are not aligned with any one course no formal teaching goes on in the space; nevertheless a great deal of informal learning and teaching happens here. We have gone to great lengths to curate the space in a way that encourages our members to interact with each other whilst using the equipment and library. Staff and student Materials Bursary schemes support members wanting to engage in materials experimentation and teaching and research through making. These schemes attract undergraduates, postgraduates and members of staff that are not the obvious 'hackspace' users. By having members from diverse backgrounds and disciplines sharing the same space, they can, and do, learn from each other. This happens organically when undergraduates learn about the practice of research by working in the same space and using the same equipment as PhD students, postdocs and staff. Equally, researchers sometimes learn about making techniques from student members. Summer Studentships have played a crucial role in developing teaching-research interaction, because they allow an undergraduate to do interdisciplinary research over the summer through a collaboration between two different departments.

We also deliberately curate themed research workshops and member events, like the Robot Egg Race and Health, Safety & Creativity Forum, that allow people with similar passions to meet and work together from very different parts of the university.

Robot-Actuated Ceramic Casting

Kate Davies, Emmanuel Vercruysse, Giles Corby, Lilah Fowler & Prof Edward Allington

This project combined the robotic fabrication expertise of the Bartlett with the Slade's material understanding and expertise in ceramic casting and firing in order to explore the creative potential of the casting process as a choreographed performance. The Bartlett team have been developing robot-controlled hollow casting, a form of rotational casting actuated by a digitally controlled robot arm, using polyurethane cast in CNC machined moulds. They initiated a joint research project with ceramics experts at the Slade to develop the process for ceramic casting, and to explore this process of making beyond its purely technical aspects as a performance in its own right. The project had three stages. The first stage focused on developing expertise and innovation in the casting process, exploring the relationship between the movement of the mould and the resultant cast objects. The team explored how bespoke choreography enacted during the casting process produced specific object qualities: asymmetrical weight distribution, variable fragility or translucency, for example. The second stage of the project framed the process as a performance. The fragile cast pieces, once fired, were remounted delicately onto the robotic arms to perform the choreographed movement sequence once more as a reenactment, constructing a dance of a number of very fragile casts moving in close proximity to each other. The third and final stage of the project involved staging and filming the original casting and reenactment as events or performances. The design of the mould geometry and robot movement sequences required expertise in both analogue and digital craft; linking knowledge and expertise in high-end robotics with an understanding of the material behaviour of ceramics to produce ultra-thin, fragile ceramic vessels.



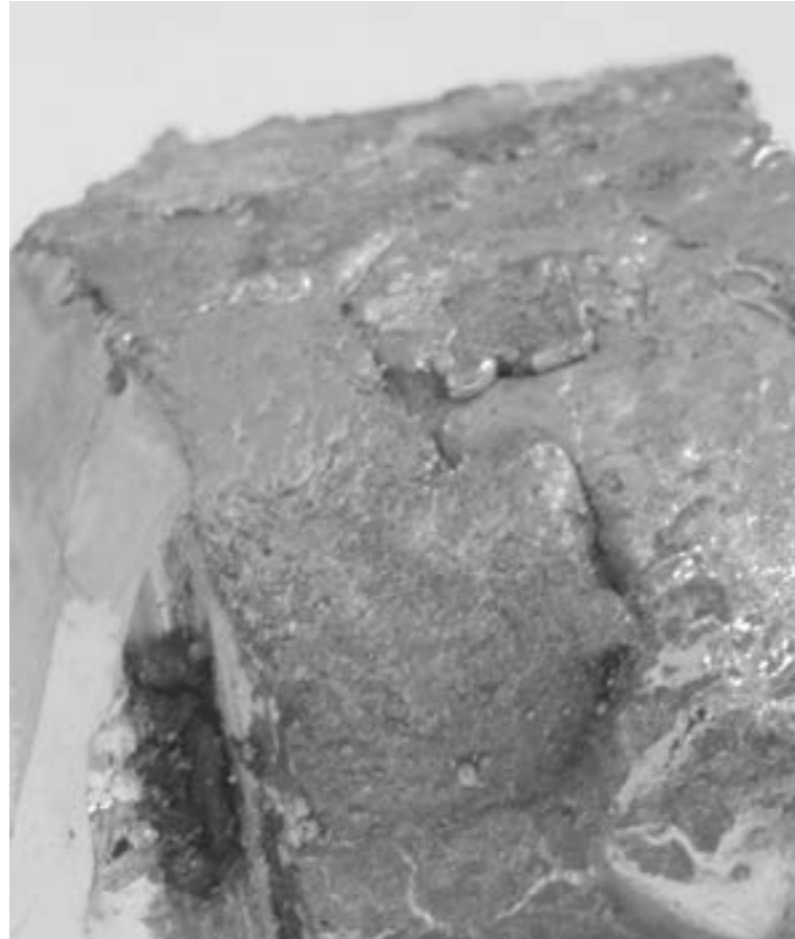
Soprano

Dr Matthew Ash, Dr Matthew Richie & Dr Kevin Chetty

The Soprano project is a collaboration between early career researchers in Electronic & Electrical Engineering and Security & Crime Science. The purpose of the project was to develop a novel radar sensor capable of identifying objects based on their subtle movements, and to locate them in range, for the purpose of increasing security in urban and indoor environments.

Radar sensors are uniquely capable of locating objects in three-dimensional space, measuring their velocity and range and identifying them based on their subtle movements. They are therefore very well-suited to applications that try to improve security in urban and indoor environments, where the location and identification of threatening behaviour can be of great value. However, urban and indoor environments can be challenging for radar systems to operate in, primarily because they comprise many objects that scatter microwave energy and make it difficult to discern objects of interest from ‘clutter’.

The Soprano team set about making a new and unique radar architecture, with a 1 metre range-resolution, to allow many sensors to work together to gather a better picture of their environment. This multi-static radar system was achieved through the development of a completely novel dual operating frequency design. The team have made two of the radar systems and tested them on moving targets to identify velocity of movement and subtle micro-motions of arms and legs that can be used for classification of behaviour.



They have also used them to demonstrate radar principles and the Doppler effect to school children as part of a Royal Institute education outreach project. Having submitted one paper to IEEE Sensors Journal and prepared several others, they are now discussing how to use this new technique in applications like non-invasive security systems, non-invasive monitoring of vulnerable people in the home, and human-machine interfaces for a connected home.

For more information: www.soprano-sense.com

Cleaning Materials

Dr Kaori O'Connor, Theodore Hayes & Prof Julian Evans

This interdisciplinary team, comprised of an anthropologist, a chemist and a materials scientist, sought to redress a lack of academic interest in the act of cleaning and cleaning materials themselves. They explored questions like: how and why do we clean; what are cleaning products made of; how do they work; and how does cleaning modify product lifetimes, affecting the environment, resource efficiency, waste reduction and sustainability?

Each researcher conducted a separate historical study, focussing on the same time period but different themes, according to their disciplinary strengths. Evans focussed on a materials history of the transition from natural materials to synthetic materials. Hayes conducted a chemical history focussing on three main types of cleaning products: laundry soaps and detergents, bleach and cream cleaners, isolating and describing the chemical processes involved. O'Connor contributed a social history of cleaning and the factors that influenced changes in cleaning products, practices and values. These separate histories were then superimposed on each other and cross-analysed to produce a chemical and social history of cleaning in modern times. For example, they explored shifts in social attitudes towards cleaning over time: at the end of the nineteenth century as a result of the promotion of everyday chemistry in domestic practice and after World War I as a result of the germ theory of disease, the medical consequences of the war and the post-war decline in domestic servants.



The team presented their research at the Society for the History of Alchemy & Chemistry (SHAC) conference, and this pilot will form the foundation of a grant proposal to be submitted later this year.

Beyond the academic impact of this research, the project team also want to combat a lack of public understanding about the cleaning products they use, enabling people to make informed choices with a direct impact on sustainability at a practical, everyday level.

Dinner With Picasso

Alaena Turner, Gary Woodley, Prof Andrew Leak, Marie Fournier & Thibaut Raboin

Over the course of six workshops, held between Feb – Sep 2014, this group of researchers from the Slade and French department explored the nature of food as a material, and the potential to innovate in food through innovation in language. The project began with a series of tastings led by food professionals, including a chef, artisan cheese-monger and an algae scientist. The second stage of the project explored the form of the recipe through writing workshops that explored experimental writing techniques associated with the Oulipo group. The writing workshops produced innovative recipes through constraint strategies, and this resulted in a collection of radical recipes. These recipes were interpreted by the research participants and presented as a multi-sensory buffet, and a selection were translated by a chef to create an Oulipean meal for the final workshop.

Through this project, the research team developed a new relationship with the History of Science and Anthropology departments at UCL, and several new collaborations have emerged as a result of it. Research participants have exhibited collectively at DOMUS MMXIV: The House Show, curated by Flore Nove Jossier and Thorbean Anderson, have contributed to the Delfina Foundation's upcoming Politics of Food season, and participated in the School Dinners project, curated by Esther Collins. Dinner with Picasso is currently looking for follow-on funding and plans to develop an Oulipo menu for submission to South London Gallery's Supper Club program.

For more information: www.dinnerwithpicasso.hotglue.me/



Summer Studentships

“Without the structure of the studentship, the help from the staff at Institute of Making and the people to whom they introduced me...there is no way I could have carried out such a personally important project. Academia allows me to explore things in depth through the medium of language but this has allowed me to research materially, historically, and socially. I am so grateful to have had this opportunity to carry out an ambitious venture. I have learnt an enormous amount and look forward to taking what I have learnt into future projects.”

(Edith Dormandy, History of Art)

Second year Edith explored iconoclasm and destruction in art and experimented with the material qualities of different waxes, resulting in various experimental maquettes and a final wax sculpture, made to be destroyed as part of UCL Art Society’s Destruction Day. Her experiments were influenced by conversations with supervisors Charles Ford (History of Art) and Karin Ruggaber (Slade) as well as members of the Institute of Making research community Dr Anna Maerker (History of Medicine at KCL), Dr Simon Werrett (STS), curator Mark Carnall (Grant Museum) and our very own Richard Gamester.

As described in the Member Profiles section (see page 34), Geography student Daniel Black took the opportunity to work with Antikythera Mechanism expert Tony Freeth and Visualisation of Cultural Heritage specialist Dr Lindsay McDonald (3DIMPact, CEGE) to recreate a physical model of part of an ancient Greek astronomical calculating machine. The team are currently looking for PhD funding to take this research forward.



Physics student Markos Karasamanis got involved in research investigating quantum effects in silicon, the most common material in the semiconductor industry. He worked with Dr Jarryd Pla (LCN) on eliminating flux vortices (topological defects) in superconducting materials. In order to achieve this, strictly aligned large magnetic fields have to be applied to the silicon chips at near absolute zero temperatures. Markos worked on making separate feedback-controlled coils to prevent the magnetic field from losing alignment. He simulated these coils at the LCN and then printed initial prototypes on our 3D printers. Supervised by Dr Paul Bartlett (Physics & Astronomy) he tested the magnetic field of the coils before fabricating a more refined prototype on the Makespace’s Object resin printer.

Mechanical Engineering student Daniel Hardej worked on a research project aimed at developing a replacement heart valve made of ‘living’ biological tissue using a novel cell-rich collagen construct created at UCL Institute of Orthopedics and Musculoskeletal Science. His role was to determine feasibility of using the collagen construct as an engineering material, with guidance from his supervisors in Mechanical Engineering and the Royal Institute of Surgery and Orthopedics.

Biochemical Engineering student Esmond Lee worked across the borders of biochemistry and regenerative medicine in a project aimed at assessing the suitability of three materials (PTFE, PLA and polycarbonate) as growth media for a bioreactor designed to grow columnar epithelial sheets for tracheal transplants. The studentship broadened his understanding of translational research, giving him an opportunity to take part in validation studies and gain key laboratory skills. The bioreactor has since been tested, and the lab are undertaking phase 1 clinical trials of the resulting epithelial sheets.

Pop Up Pop Up

Dr Hilary Powell, Leverhulme Artist in Residence, Chemistry

“Being involved with Hilary’s work made me realize how important it is to think big when you are dreaming up a project and to push yourself to achieve it.”

(Laura Dempsey, Medical Physics)

Hilary used her Small Research Grant to put together a public production line to make a pop-up book in an industrial building in Stratford, returning skilled craft and cultural production to a site of former manufacturing. ‘Legend: An A-Z of the Lea Valley’ charts an imaginative history of this changing area and unites contemporary and traditional manufacturing methods, including digital printing, laser cutting and bookbinding.

A team of ‘pop-up apprentices’ were recruited from a range of UCL departments including Biochemistry, Engineering, the Library and the Bartlett. The apprentices received coaching in paper engineering, bookbinding and printing techniques and were then given responsibility for the production line. They brought care and energy to completing as many books as possible, resulting in the formation of a dedicated and tight-knit team who shared their skills and experience. Over 250 people visited the production line to talk to the apprentices and explore the space. The team all received a copy of the book, which won the London Art Book Fair’s Birgit Skiold Award for Excellence, is represented by Kaleid Editions and has been acquired by collections including the V&A National Art Library, Saison Poetry Library and MoMA NY Library.

For more information: www.popuppopup.net

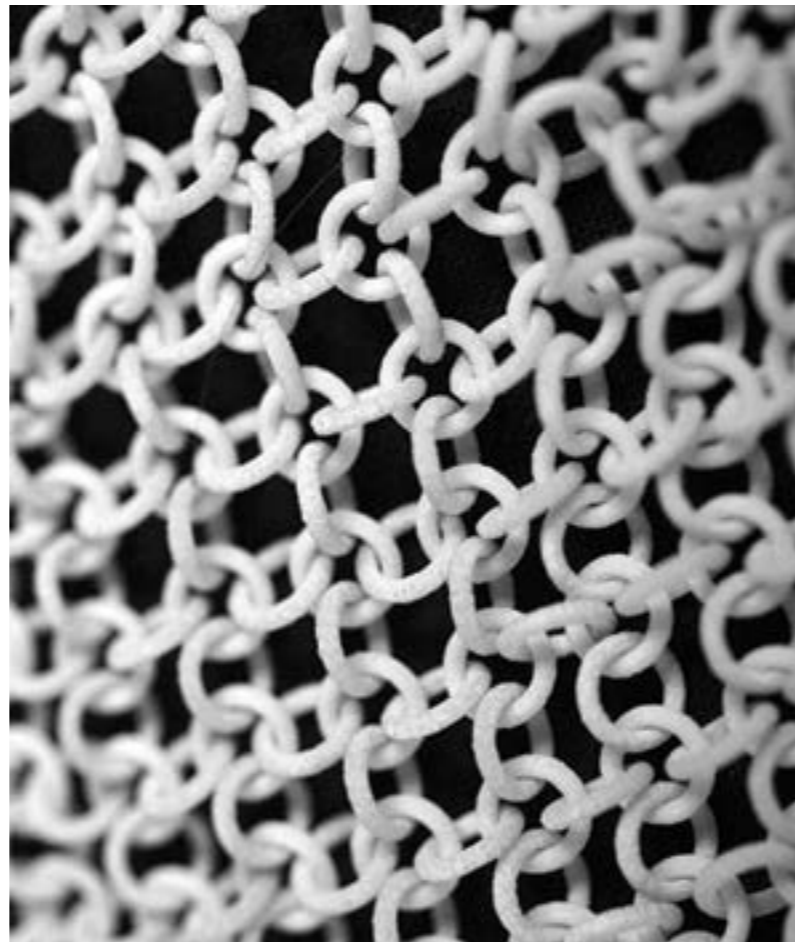


A Platform for New 3D Printable Materials

Dr Richard Jackson & Dr Paul Southern

Richard and Paul are early career post-doc researchers in Biomedical Engineering who have been using their Staff Materials Bursary to create a temperature-controlled environment for a 3D printer and a plastic extruder for the production of multifunctional printable plastic filaments that incorporate micro- and nano-materials. They wanted to extend their 3D printing capabilities to produce useful printable materials for a number of collaborative research projects. Their modified filament extruder allowed them to experiment with printing a variety of functional materials, including magnetic nanoparticle hyperthermia-activated polymers for the treatment of prostate cancer, biodegradable polymers for *in vivo* implants, light-activated antimicrobial materials and conductive polymers that can be used as skin sensors for wearable assistive materials (see page 52).

Richard and Paul also made a temperature-controlled environment to avoid the warping of prints and improve accuracy. This allowed them to extend the range of printable materials to those that ‘cure’ above room temperature for example. They encountered a few obstacles in making and experimenting with their kit: only a handful of people have made their own extruders so there are few precedents and not much technical support online. The temperatures, forces and tolerances involved in printing these hybrid materials can also be problematic, so the making process involved a lot of trial and error. However, they both expounded the benefits of ‘giving it a go’: because of the complexity of the plastics industry, what may be possible at an industrial scale may not be in a small research lab, but equally something that is impossible at a large scale may be achievable at the level of blue sky research.



As early career researchers, this kind of small grant for pilot projects and making equipment is ideal as they were able to make the equipment they needed much more quickly, and with no immediate requirements to publish. The project allowed them to experiment, produce a proof-of-concept, and has given them the confidence to apply for larger grants.

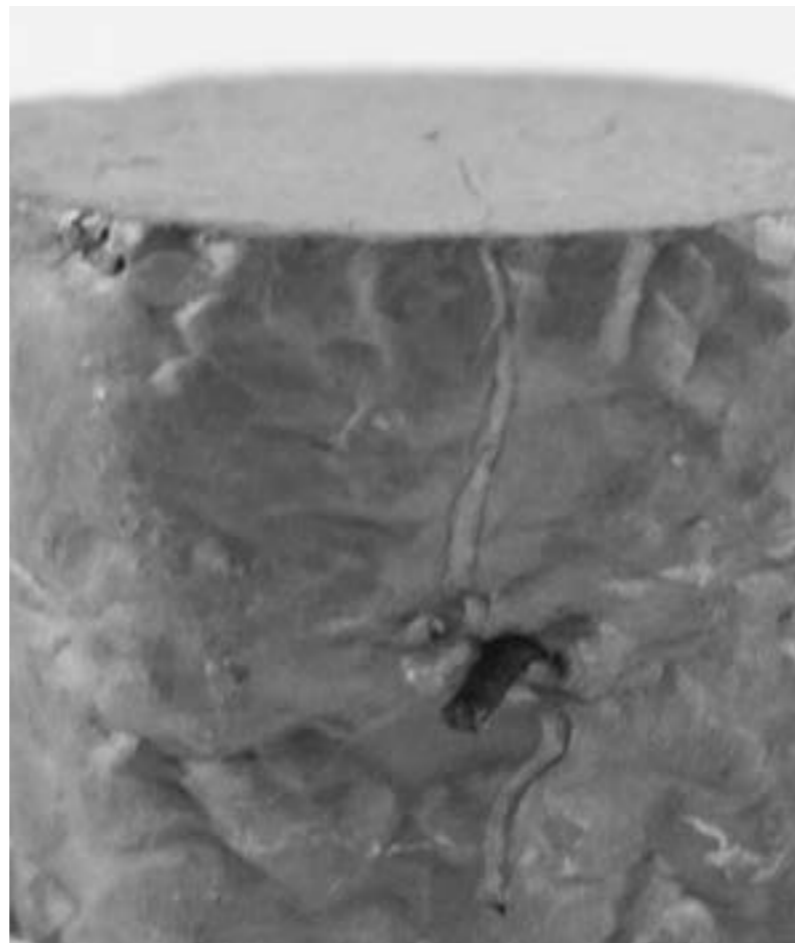
In terms of the future of this project, Richard and Paul are just getting started. They will carry on developing and refining the aforementioned multifunctional materials and they are also starting a new research collaboration instigated by WAM PhD student Mark Ransley as the result of a chance encounter in the Institute of Making. They will be working with Dr Ben Coxford (Bartlett School of Environment, Energy and Resources) to develop materials for bioactive building structures in developing countries.

Forecast, Recast Subhadra Das & Ling Chiu

Subhadra (Curator, Teaching & Research Collections) and Ling (Curatorial Assistant, UCL Art Museum) won a Staff Materials Bursary to recast a pair of printing plates from the UCL Galton Collection. The metal plates are of historical significance as they were printed in *The Times* in 1875, making them the first popularised weather maps. The project was inspired by Subhadra's teaching for the BASc Arts & Sciences programme. Drawing on Ling's printmaking expertise and Subhadra's knowledge of the collection the duo seized the opportunity to take a practical and experimental approach to the museum objects.

With the help of the Institute of Archaeology they used a portable XRF machine to analyse the material constituents of the plates. They then set about recreating them in a three-stage process, with the help of Institute of Making staff. They made moulds of the plates with an inert and heat-resistant silicone rubber, cast a replica in a pewter similar to the original material of the plates, and then created a second version in resin. Because of inconsistencies in the pewter casting process the metal plates were not high-quality enough to print from, but the recast resin plate was very successful. They then set about creating prints using a Slade printmaking press that would have been contemporaneous with the original plates.

This project served several purposes. Firstly, Subhadra and Ling were able to create a handling object that can now be used by museum audiences to make prints, adding an extra dimension to the visitors' experience and understanding of the objects. In recreating the plate-making process, they also engaged in a kind of 'experimental



archaeology of the collection', adding to their understanding of the plates by exploring their context and provenance.

Not only was it great fun to take a museum object out of its drawer and use it in an innovative way, but this project set a precedent for the museum sector. They are now planning to publish a paper on their work, which provides a model for practical and experimental engagements with fragile and irreplaceable museum objects.

Material Storeys

Helen Storey, Dr Kate Storey and the Wellcome Trust

Collaborating sisters Helen Storey, a well-known British fashion designer, and Kate Storey, a renowned biologist, have brought together a diverse team of Institute of Making members to be experimental material developers for their new Wellcome Trust funded project. In 1997 the Storeys made a body of art comprising of 27 dresses that interpreted the first 1000 hours of life. The critically acclaimed collection named Primitive Streak spanned their disciplines of social art, fashion design and cell biology. This was funded by one of the first Wellcome SciArt prizes, touring ever since to reach millions of people in 8 countries, critically and publicly acclaimed as a 'cultural hybrid'. In the run-up to the Wellcome Trust 75th Anniversary they were commissioned to make new work nearly 20 years on which reflects their current research. Kate Storey's recent research has observed neurogenesis: complex cell behaviour during the process of cells in the spinal cord developing into neurons. Helen and Kate are working together to elucidate the process of neurogenesis through material qualities, which Helen will work into large-scale artwork to be installed in the Wellcome's new reading rooms. An enthusiastic team of our members is working with the Storeys to develop interesting material ideas and properties.

Participants include students, researchers and staff from Anthropology, the Slade School of Fine Art, Biosciences, Civil Engineering, Chemistry, UCL Medical School, the Bartlett School of Architecture, Mechanical Engineering and CoMPLEX among others (see Appendix for names of participants).

Watch the project unfold via the blog: www.materialstoreys.tumblr.com

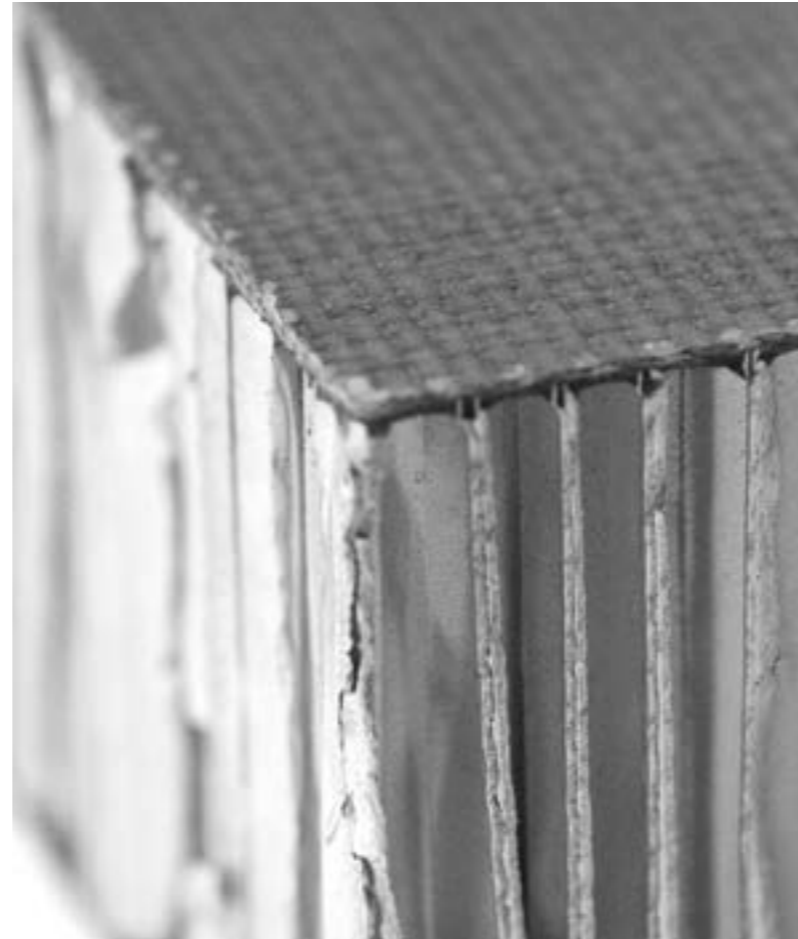


LEGO2NANO 2014

UCL, LCN, Tsinghua & Peking University

For the second year running an interdisciplinary group of Institute of Making members took part in LEGO2NANO, this time to develop last year's exciting international collaborative citizen science design project and make low cost scientific instruments a reality for kids in China. They worked together to build and present a working Atomic Force Microscope (AFM) capable of seeing objects only a millionth of a millimetre in size, for a few hundred pounds. Research grade equipment like this typically costs over £60,000, but this project's ongoing aim is to capitalise on the new knowledge and lateral thinking of our members in order to recreate the basic functions of these complicated machines, and make them cheap enough to put research tools and skills into the hands of young people all over the world.

Over the course of just one week in Beijing, 12 of our UCL members, alongside 12 students from China, used components and lasers from broken games consoles and LEGO with cheap 3D printers to develop, build and programme a new kind of low-cost AFM. They divided into four teams: hardware, software, crowdfunding and crowdtesting, with the aim to achieve a working open source design for the AFM that can be downloaded and built by high school students in China and the world over, enabling them to explore materials on a nano-scale and upload their findings to an online database. More data means more knowledge, and low-cost equipment like this, coupled with an open science and open source approach means that non-scientists like high school students can get hands-on, and get involved in real science.



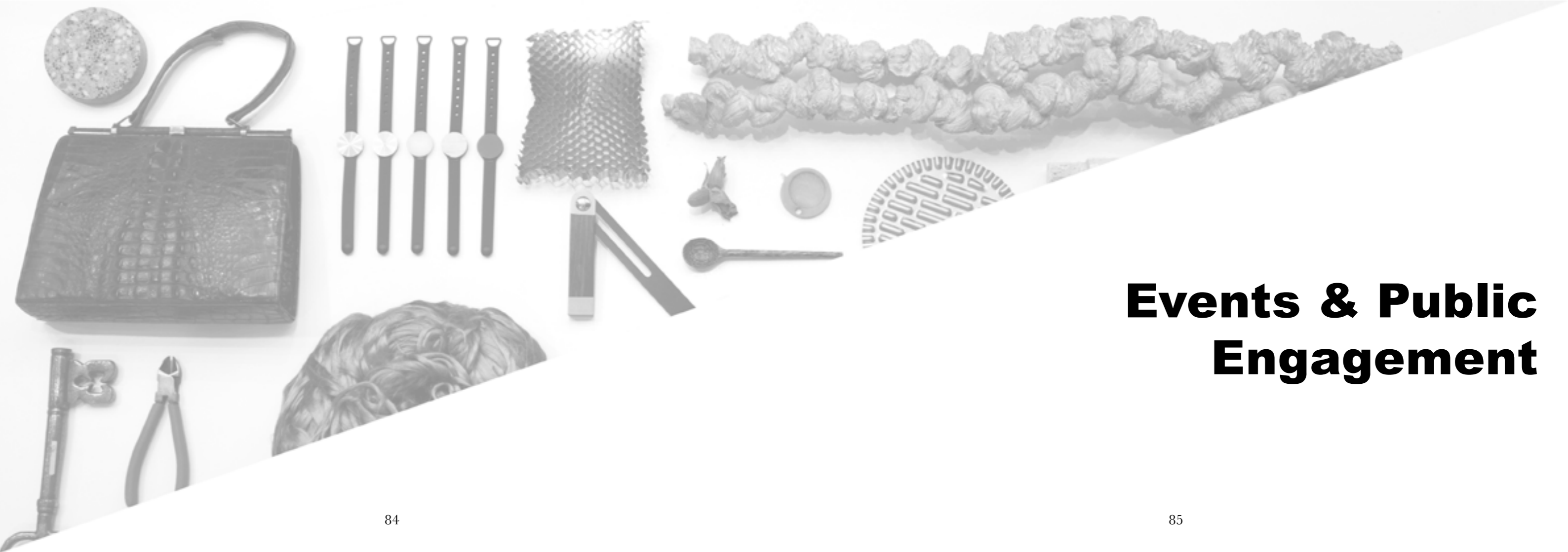
This year the project continues with the aim of turning the AFM into a multifunctioning device, capable of capturing different kinds of data, like seismic vibrations for example. The teams are becoming more diverse, with students and researchers recruited from UCL, LCN and Tsinghua Universities focusing on hardware, software, online learning, child psychology and entrepreneurship.

We are collaborating with UCL's engineering education programme and Tsinghua's Lifelong Learning Lab to create new ways of hands-on learning, getting kids interested in making, participating in real science and engineering.

LEGO2NANO has attracted interest from universities, makers, press and researchers all over the world. Four of our participants are presenting a paper at this year's International Design for Children Conference in Boston. They will also be hosted by MIT media lab for a week to present, promote progress and share their ideas.

For more information: www.instituteofmaking.org.uk/research/lego2nano

For live updates, follow @LEGO2NANO



Events & Public Engagement

“Hello, Just felt the need to send you a quick email to thank you all for doing what you do. I came to your Carbon open day today and brought my kids and their cousin with me this time. Aged 5, 7 and 7 they sucked it all up and went to bed early because their heads were stuffed full. I can hear the whirring and crunching going on now, in their brains as they sleep. Tomorrow I know there will be loads of questions and speculations and imagined inventions and it’s just great. Please pass on my heartfelt admiration for all the team. You people are doing one of the best jobs in the world. All power to you!”

(Phil Hall)

Our events and public engagement programme is designed to inspire our members and the public to explore new areas of interest, acquire new skills, and engage with experts in diverse fields of materials research and making.

We organise several different types of event ranging from masterclasses run by expert makers for small groups of members to large scale public extravaganzas, talks, seminars and workshops. Each type of event enables those attending to gain an insight into the practice and philosophy of expert makers and a chance to discuss broader issues around materials and making. The research workshops are focused on specific research themes, and gather together experts and enthusiasts working in related areas to share their ideas and discuss the issues surrounding their topic, with an explicit aim of creating new interdisciplinary research collaborations.

From March 2014 - March 2015 we held 69 events, 39 of which were member events and 30 of which were public (see pages 154-157 of the Appendix for the full list of events). These included 32 masterclasses (Soap Making, 3D Scanning and Millinery for example), 15 research events, 4 Materials Library evenings, 4 corporate events, 3 outreach events, 3 big public open days (Carbon, Robots and Metals), 2 factory



tours (Closed Loop Recycling and the Ford Factory) and 1 talk (The History of Robots). All of our events are extremely popular, with many being booked up in less than 2 minutes of being released and with extensive waiting lists forming.

In 2014 we also held our first 5 day Festival of Stuff dedicated to our public audience. The festival had 4 days of action-packed masterclasses including felting, soap making, animatronics, arduino workshops, blacksmithing and wooden spoon carving and turning. It culminated in a Saturday extravaganza: we spilled out onto the street outside filling it with demo stalls and making stations, making it bigger and better than ever before. We brought back some old favourites like spoon carving, blacksmithing and rope making along with some new discoveries like electronics sessions by Technology Will Save Us, suturing pig skins and a very tense Log to Leg race. All 18 masterclasses for the Festival of Stuff sold out within 5 minutes and the whole festival had a total audience of more than 1000 including a high representation from families and children.

Over the past year all of our events have attracted a total audience of more than 5000. The demand for our events far outstrips supply, and to cope with the large volume of people who attend, we regularly recruit both staff and students as volunteers to help on these occasions. Through these events the public get both a taste of the Makespace and Materials Library, and a chance to meet and interact with our wonderful and knowledgeable community of members.

Closed Loop Recycling (Factory Tour)

This was one of the first in a new series of events where we visit a variety of different factories of all scales. These tours aim to enrich the members' events series, linking them with industry and giving them insight into different levels of production. To kick off the series we headed out to Dagenham to visit Closed Loop Recycling. This facility specialises in recycling food-grade materials from polyethylene terephthalate (PET) drinks bottles and high density polyethylene (HDPE) milk bottles, reprocessing 35,000 tonnes of mixed plastic bottles every year!

During the sorting process milk bottles and bottle caps are cut down into small chips and sent through an infrared detection process to separate the opaque, coloured caps from the clear bottle waste. As this detection process is not completely accurate, a few coloured chips make their way past the sorting process. Because the most common coloured bottle caps are green, the resulting plastic has a slightly verdant tint.



Festival of Stuff (Masterclasses)

This was a 5 day festival of materials and making, aimed aimed at a public audience of adults and children, and bringing back the most popular masterclasses from throughout the year. Each day held a series of masterclasses on different themes including felting, electronics, the Materials Library, blacksmithing and woodworking. All 18 masterclasses sold out within minutes.

The first day focused on felt with 2 felting masterclasses from Heather Belcher, 2 millinery masterclasses with Sahar Freemantle, and 2 soap making workshops. The second day centred on electronics and involved an Arduino session for beginners with Prof Mark Handley, animatronics with Matthew Walker, and 2 Materials Library evening sessions. The third day comprised of three hands-on blacksmithing masterclasses with Artisan Ironwork. The fourth day was wood-themed and featured 3 spoon carving masterclasses with Barn the Spoon and two wood turning masterclasses with Jim Steele on a pole lathe and Stuart King on a power lathe.



Festival of Stuff (Open Day)

800 people came to the Saturday finale of the Festival of Stuff, where we took over Malet Place filling it with demo stalls and making stations. The extravaganza brought back some old favourites such as the science of designing and making the perfect paper aeroplane, spoon carving with Barn the Spoon, Artisan Ironwork blacksmithing, rope making with Des Pawson, and polymorph shaping and moulding.

Alongside this we had some new discoveries including basic electronics with Technology Will Save Us, suturing pigs skin with Skinship, bodging with Jasleen Kaur and DNA extraction with gin. Participants could taste the difference between two ice creams: the Institute of Making's secret liquid nitrogen recipe and soft scoop Mr Whippy ice cream. The day ended with a very tense Log to Leg Race between last year's champion Jim Steele and newcomer Barn the Spoon: this year's trophy was won by Jim.



Health, Safety & Creativity (Research Event)

In October a multidisciplinary group of researchers got together at the Institute of Making for a discussion of health, safety & creativity in making practice. The group of materials and health enthusiasts included a chemist, conservator, ceramicist, geoarchaeologist, printmaker, two sculptor/fabricators, an anthropologist, a historian and several health and safety professionals. The forum focused on the perceived risks, toxicological effects and benefits of materials used in art practice and making. Discussions also attempted to move beyond a narrow critique of 'sick' materials and products: the group also explored the positive physical and mental effects and the pleasures of working and experimenting with materials.

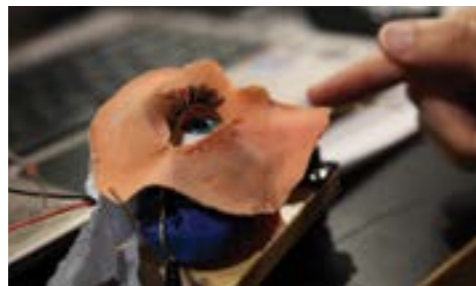
As a provocation for discussion we played 'risky materials pass-the-parcel'. Participants donned PPE gear (nitrile and leather gloves, fire retardant aprons and boiler suits, goggles and respirators) and tried to rip their way through the layers of the enormous bundle to reveal objects like our leaded pewter teapot and Fiestaware cup with its radioactive glaze. These Materials Library objects were chosen to encourage discussion of the relationship between perceived risk and actual toxicological danger and the ways in which attitudes to materials in everyday consumer products have changed over time.

On the back of this successful event the group put together a proposal for the UCL Octagon Gallery call on the theme of Fabrication, which they have just won. They are busy preparing for the exhibition and planning other funding applications on the topic for submission later this year.



Robots Week (UCL Open Week)

Every lunchtime for a week we threw open the doors to all UCL staff and students to take a look around the workshop and sign up to become members. Over the course of the week we had a variety of robots for visitors to see, interact with and even have a go at controlling. RoboThespian, a life-size humanoid robot, was hanging out in the Materials Library. Visitors got to have a go at drawing with a mini Kuka 8-axis robotic arm, and UCL Computer Science demonstrated the Shadow Dextrous Hand, the closest robotic approximation of a human hand currently in existence. Members of the LEGO2NANO team also demonstrated their open-source AFM microscope made from LEGO (see page 82). For the duration of the week members could book onto a range of masterclasses and workshops, including Animatronics, CNC Milling and Experimental Laser Cutting, where we broke the world record for the largest laser cutter. We finished the week with a talk by Iain Duncan, who has been involved with robotics, automation and control systems for most of his long career.



The Great Robot Egg Race (Members' Opportunity)

This members' challenge was a nail-biting race to the finish line carrying a fresh egg through a technically tricky obstacle course made by our technicians. Original robots were designed, made and operated by interdisciplinary race teams of members from all over UCL.

In preparation for the event we offered making sessions in Arduino: one working with stepper motors, DC motors and servos, and another that focused on Bluetooth and other remote control methods. This meant that members with little or no experience of electronics or programming were able to take part, and we were pleasantly surprised by the mix of disciplines, genders and skills making up each team.

Prize categories were Fastest Robot, Mr Personality, and All-Round Best in Show, and there was a top prize of £300 for the winning team. Our judges were roboticist Iain Duncan, our Creative Director Zoe Laughlin, and the ever-ingenious computer



scientist Prof Mark Handley. The teams were Nocturne (Electronic Engineering students), The Eggsperts (Medical Physics and Engineering), Cybercitizens (a librarian and a playwright) and Hungry for Egg (a sculptor and an astrophysicist).

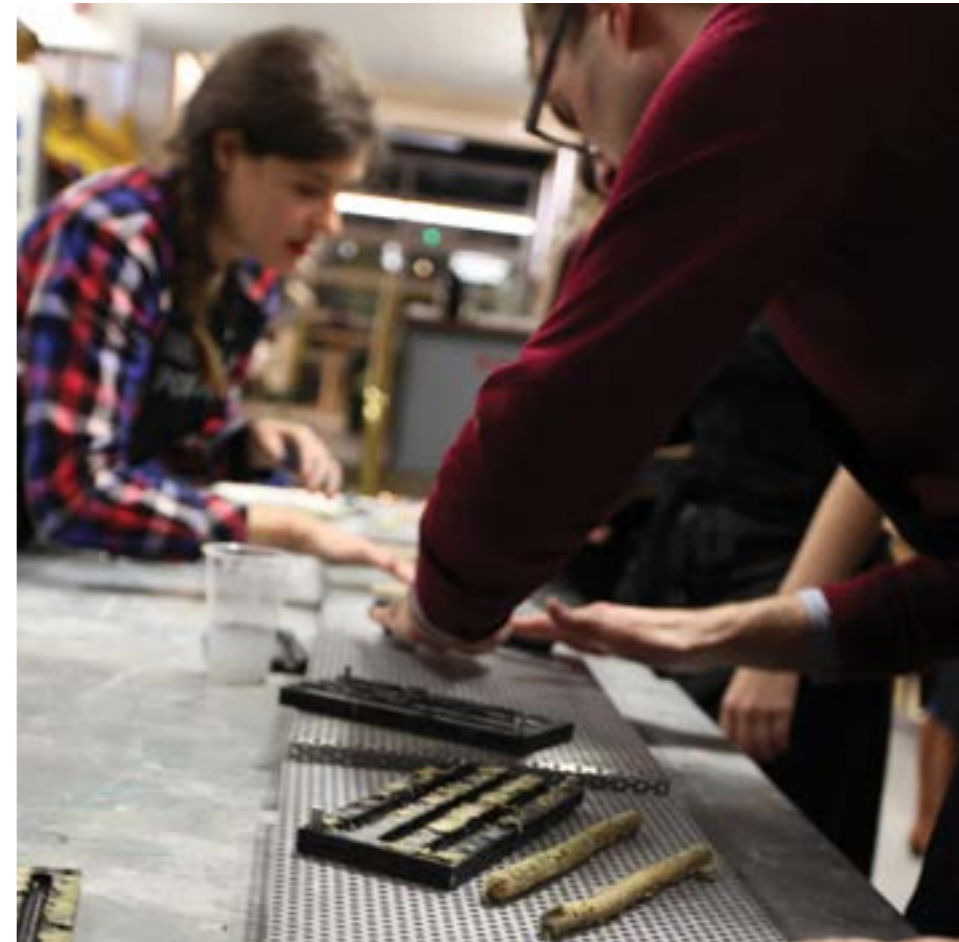
The robots needed to collect a raw egg from the patch of grass at the start of the race, then travel a variety of fiendishly difficult terrains, straddle a cube, go under a limbo pole, negotiate a sideways camber and navigate a slalom course to finally deliver the raw, un-smashed egg into a pan. There was tough competition and the tension was high all the way through the race. There was a great variety of specialisms and design features in the robots, including cast silicon skins, extendable legs, sparkly egg scoopers, slow and strong motors versus speedy and unstable. After much hilarity and deliberation from the judges, the overall winners were the The Eggsperts!

The members of team Eggsperts have gone on to recently host the inaugural meeting of the UCL Robotics society, and are using the Great Egg Race prize money to kick-start the group. The race has also led to a collaborative partnership with the UCL Computer Science Department's impressive robotics facilities in the Virtual Environments lab next door. Members can apply to use or create software and apps for the Kuka LBR robotic arm, the Shadow Dexterous Hand, and the RoboThespian RT3, a life-size humanoid robot.

Pencil Making (Masterclass)

Designer Ariane Prin taught participants how to make pencils using simple recycled materials. They used a variety of readily-available materials to make the inside 'lead' and the outer casing of the pencil. For the core you could use the standard mix of clay and liquid graphite, but the group were also encouraged to try out other materials that could be great for writing. For the outer casing a mix of paper pulp and sawdust creates a natural pencil casing, but participants were encouraged to experiment. Would adding wax to the casing help to make the pencil firmer, for example? Ariane led the group on a journey of material exploration through pencil making.

Based in East London, Ariane Prin's studio is home to a wide variety of joyously messy material experiments. All of her projects originate in specific social and environmental contexts, with materials chosen for their relation to the locality. Her work focus in making site-specific connections between human activities and environmental principles.



Carbon (Open Day)

Last November we partnered with the Crafts Council, the V&A and the RSA to stage a London-wide extravaganza of materials and making, called Make:Shift:Do. As part of this, the Institute of Making hosted a public open day around the theme of Carbon. Visitors were encouraged to explore this diverse element by making graphene, chiselling coal, watching as carbonated drinks were produced before their eyes (and then sampling them), learning the art of the perfect toasted marshmallow, discussing the carbon footprint of different foodstuffs and exploring the properties of carbon fibre. There was a chance to lift one of the world's lightest carbon fibre bike frames and see an example of carbon nanotube twine, straight from Cambridge University's research labs. Visitors simultaneously cleaned and blackened their teeth with minty-fresh carbon toothpaste and watched marvellous science demos by Andres Tretiakov. A number of our favourite carbon related materials from the Materials Library were on hand to visitors to explore, including our collection of fluorescent diamonds.



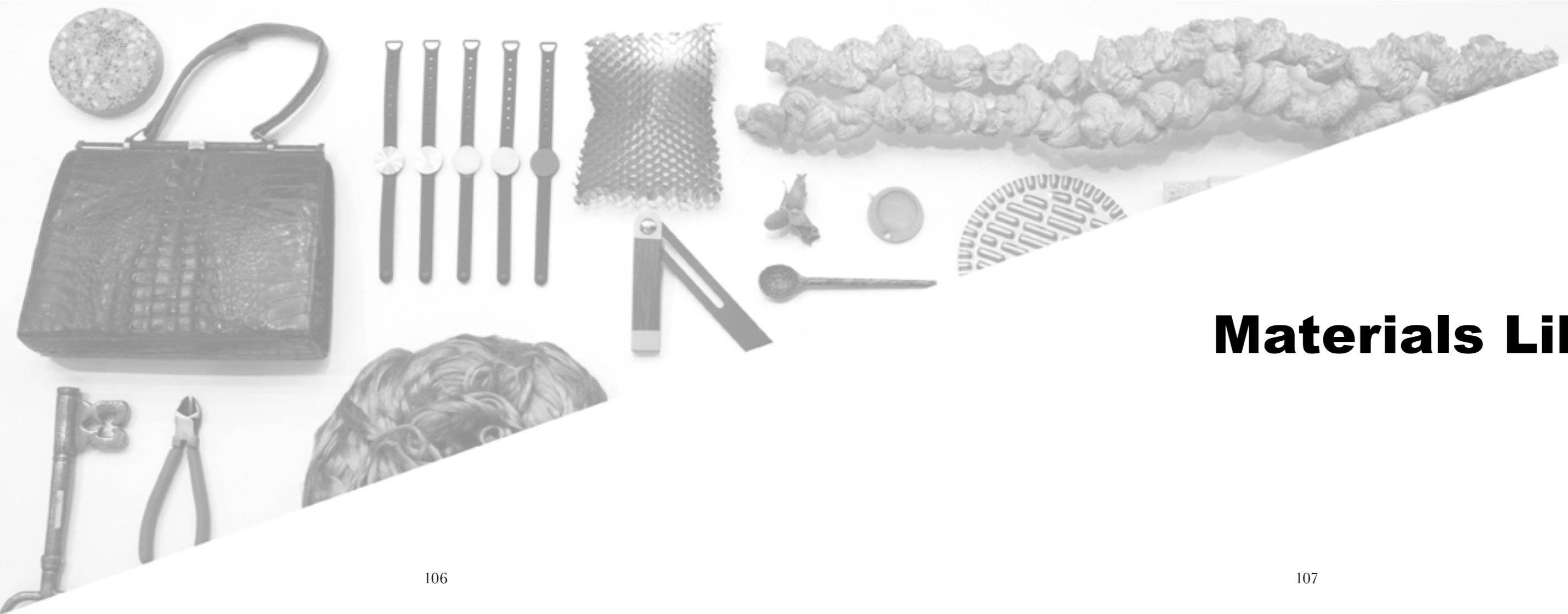
Materials Library Evening (Public Event)

In the third of a new series of public events, we opened up the Materials Library for the evening and encouraged attendees to explore the collection and to see, touch, discuss and learn more about the extraordinary material world that surrounds us.

The central theme for the February event was glass, and the evening included a History of Glass presentation by Professor Mark Miodownik and an experimental sugar glass workshop session with designer and gastronomer Fernando Laposse.

Participants shaped, moulded, welded and smashed their way towards learning more about the physical properties of sugar glass. The evening also included hands-on engagement with glassy items from the collection and opportunities for one-on-one materials consultancy with the Institute of Making team.





Materials Library

“I’ve never seen anything like the Materials Library before. It makes me appreciate my subject more. It’s nice to realise that what I know is applicable to all this amazing stuff. It’s a really effective way to explore materials science.”

(Anna Ploszajski, Chemistry)

The Materials Library is a collection of some of the most wondrous materials on earth, gathered from sheds, labs, grottoes and repositories from around the world. It is a resource, laboratory, studio and playground for the curious and material-minded to conduct hands-on research through truly interdisciplinary inquiry.



Materials Library App

“The Materials Library app is a resource essential for anyone who is interested in material, matter, substance, etc.”

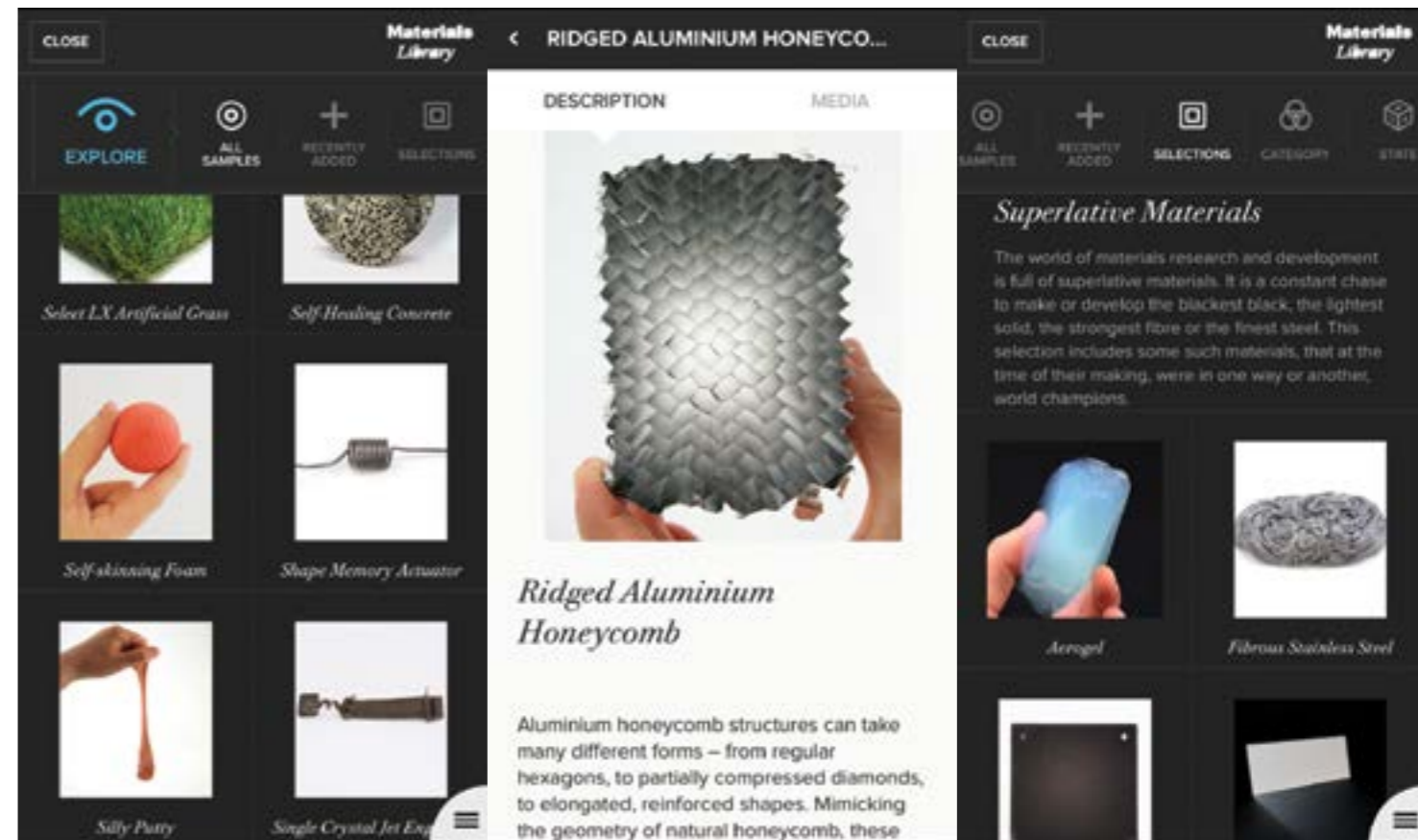
(Daniel Jones, Sound and Systems Artist)

This year the Institute of Making team launched the Materials Library App, which is designed to function as both a virtual repository of material knowledge and as a tool that enables users to navigate the physical collection. The App allows users to search for, browse and discover some of the marvels of the material world; from metals with memory and super-tough ceramics, to self-healing concrete and radioactive glass.

Each material profile features both text and images, and many of the profiles also contain video and audio content. Browsers can either enter their own search terms such as ‘blue’, ‘flexible’ or ‘chrome’ and see what is revealed, or they can explore the whole collection through various pathways of classification and curated groupings including ‘liquids’, ‘edible’, ‘biocompatible’, ‘self-healing’ and ‘squidgy’.

As well as allowing users to navigate our Materials Library, the app serves as a snapshot of the material world and a celebration of the art, craft, science and culture of matter.

The App can be downloaded for free via the Apple App Store.



Materials Library Online

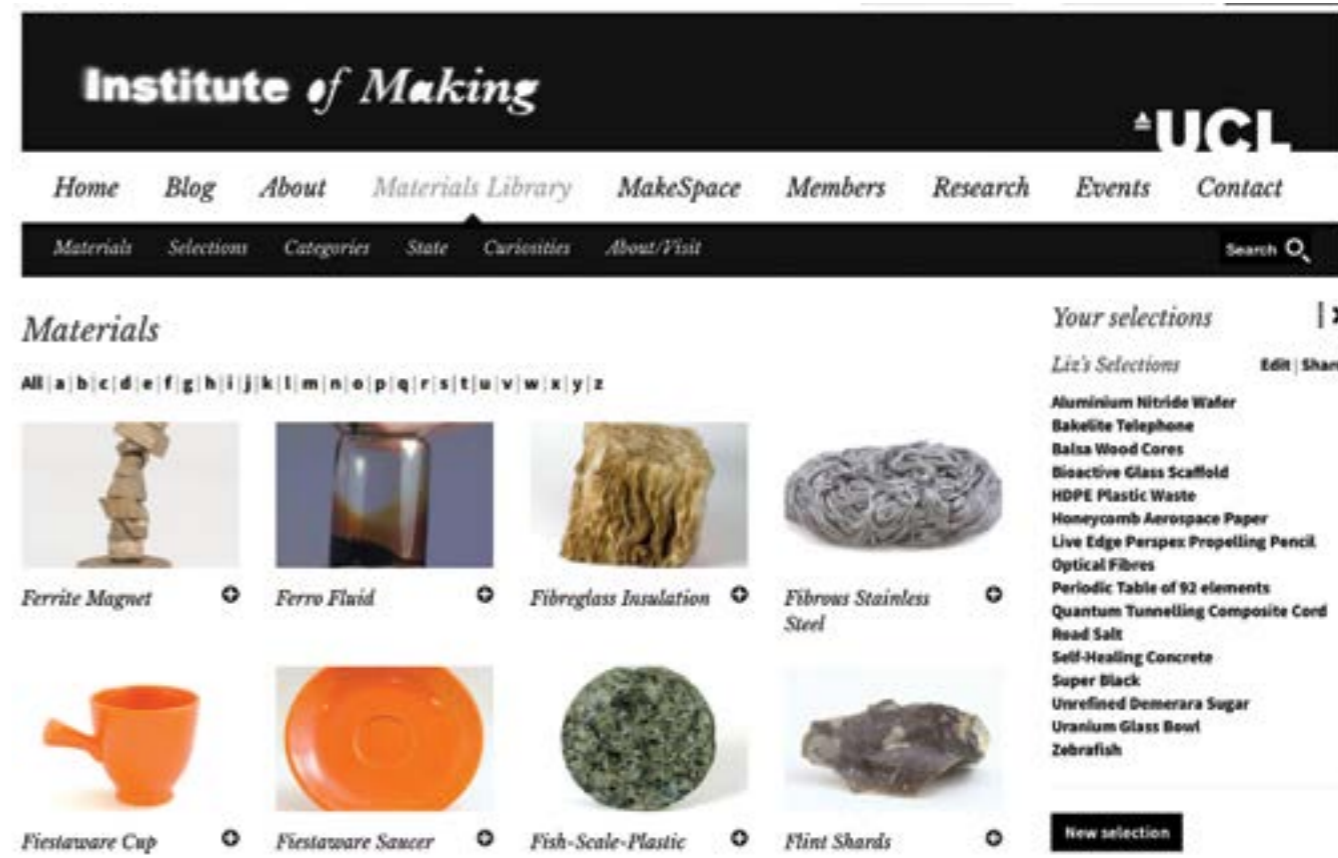
The Materials Library collection can now also be browsed online through Institute of Making website, making it available to the 50,000 plus people that visit our site each year from all over the world.

The online database mimics the Materials Library App in structure and content but also enables people to share content via social media. Users can also create their own groupings of favourite materials based on their particular interests, research parameters and expertise, saving these under headings of their own choosing.

Each material profile contains text, photos and wherever possible, video content that enriches the experience of the material and demonstrates something of its properties. The new Institute of Making Vine account had provided a platform for the generation of short video content for the app and the web version of the database.



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The screenshot shows the 'Institute of Making' website. The header features the logo and the UCL logo. A navigation menu includes links for Home, Blog, About, Materials Library, MakeSpace, Members, Research, Events, and Contact. Below this is a secondary menu with links for Materials, Selections, Categories, State, Curiosities, and About/Visit, along with a search bar. The main content area is titled 'Materials' and displays a grid of material profiles. Each profile includes a small image and a title: Ferrite Magnet, Ferro Fluid, Fibreglass Insulation, Fibrous Stainless Steel, FiestaWare Cup, FiestaWare Saucer, Fish-Scale-Plastic, and Flint Shards. To the right, there is a 'Your selections' section with a list of materials and a 'New selection' button.

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Materials Library Open Clinics

This year marked the introduction of a new series of Materials Library Open Clinics. These sessions are open to all of our members on a drop-in basis, giving our 4,000 plus members a chance to explore the collection in greater detail and get materials advice from the Institute of Making team.

The Open Clinics give makers, researchers and enthusiasts from all disciplines across UCL a chance come together to see, touch, investigate and discuss the Materials Library collection with our expert team of materials researchers. They provide an opportunity for members to share, develop and apply their knowledge.

These sessions have proved particularly popular with students from the Bartlett School of Architecture and Slade School of Fine Art, serving as a successful example of teaching-research interaction.



Fibrous Stainless Steel

These super fine wisps of grey fluff are in fact tiny filaments of stainless steel. Each strand is around a 10th of the thickness of a human hair and make for a form of steel like no other – one that is soft and able to be spun into yarns and woven into cloth.

For some a joy, and for others a skin irritant, these metallic fibres are so fine that they offer a tickling sensation when touched. Even more sensational; if you hold a magnet against the fibres you can see each little hair rise and fall. Retaining the strength of steel whilst at the same time remaining incredibly light, the fibres can be combined with other materials to produce a variety of effects, like embedded conductivity and structural reinforcement for example.

Particularities

State: Solid

Category: Metal

Relationships: Steel, Textile, Silver, Metallic, Hair, Yarn, Stainless



HDPE Plastic Waste

HDPE is the type of polymer most often used in the making of new and recycled plastic bottles. When bottles arrive at recycling plants they are passed through a giant shredder and chopped up to produce flakes of plastic. The flakes are then passed through a colour sorter to filter out dyed from non-dyed plastics. The non-dyed chips are then heated to temperatures of over 200°C and turned into molten plastic. The molten plastic is then extruded, filtered, cut into small pellets and cooled. These pellets are sold on to make new food containers and bottles of various levels of recycled content.

This sample came about during the final extrusion process when waste material is excreted out of the extrusion machine, spilling onto the factory floor. These blobs of plastic are collected and sold on for use in non food-safe grade recycled products. The reason that this blob has a slightly green colour is that occasionally coloured flakes evade the sorting process and make it into the pile of white flakes. As the most common coloured cap in circulation across the UK today is green (semi-skimmed milk) the resultant recycled plastic often takes on a slight green tinge. To lessen this greening effect the amount of dye in British semi-skimmed milk bottle lids has been reduced.

Particularities

State: Solid

Category: Polymer

Relationships: Green, Plastic, Recycled, Milk, Extrusion, Flakes, Blob



Bioactive Glass Scaffold

When you break a bone in your body, the bone is only able to repair itself effectively if all of the original material is present and a good contact can be forged between the fragments. This bioactive glass scaffold is designed to help in situations where these conditions are not met. It sits between fragments of bone in place of missing material. However, the glass doesn't replace the bone fragment permanently; it acts as a bridge for natural bone growth. As the bone grows it consumes the scaffold, eventually leading to a perfectly fused join. The scaffold is porous and contains an interconnected network of pores so that cells, blood vessels and new bone can penetrate into the material.

Materially, the scaffold has to possess a number of important characteristics. It needs to be biocompatible so the body doesn't reject it, it needs to be bioactive so it will promote the growth of new bone, it needs to withstand the same loads as the surrounding bone, and it must degrade as new bone grows through it.

Particularities

State: Solid

Category: Glass, Mineral

Relationships: White, Brittle, Porous, Bone



Self-Healing Concrete

In the future we may be surrounded by concrete structures that are able to self-heal cracks in their structure, with special bacteria doing the job for us. Tiny cracks in concrete do not necessarily affect structural integrity in the short term, but they do allow water and other chemicals to seep into the structure, which may cause mechanical failure in the long term.

Self-healing concrete has dormant bacteria and a food source (starch) embedded in the concrete. When a crack appears in the concrete, water seeps in and reactivates the bacteria. After they awaken, the bacteria eat their packed lunch and then conveniently excrete calcite, which heals the crack. The bacteria can survive dormant in the material for 50 years.

Particularities

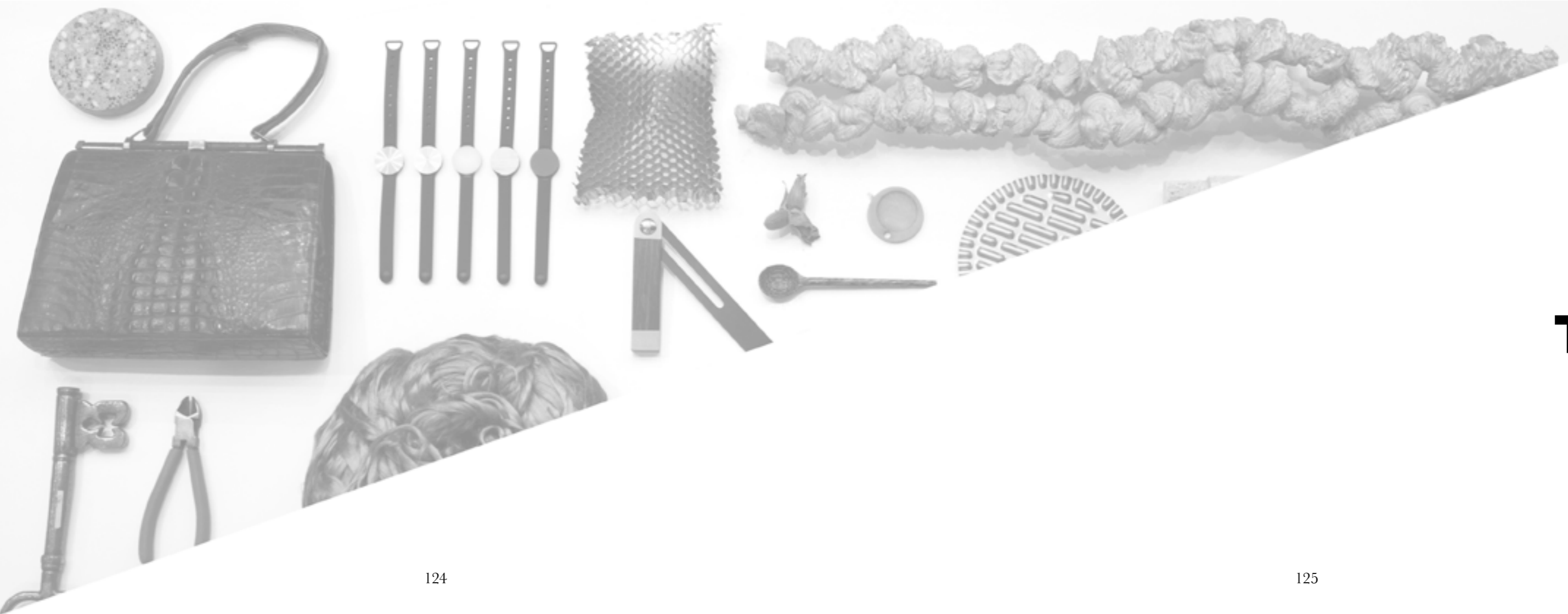
State: Solid

Category: Ceramic, Composite

Relationships: Concrete, Disk, Bacteria, Grey, Self-healing, Poo

Curiosities: Repair





Tools

This second year of operation has seen the workshop go from strength to strength, continuing to grow not only in numbers and the broad spectrum of members using it, but also in the resources we can offer. We have continued to build upon the foundations we laid in the first year, fine tuning every aspect to ensure our members have the very best experience possible. In particular we have installed another laser cutter, new Ultimaker 3D printers, a new throwing wheel, woodworking machinery and a metal lathe.

By listening to feedback and observing how the space was being used, we made a few minor changes to the layout, which has resulted in a much more efficient and user-friendly space. The mezzanine is a particularly good example of this. By simply moving a few tables and benches this area became the main hub for our members to congregate and collaborate. As a result of popular demand we have created a dedicated area for ceramics. As our inventory of equipment has grown we have also continued to be masters of creative storage solutions, building more shelves and cupboards in the most unlikely of spaces.

In the future we are aiming to develop areas dedicated to plaster turning, glass processes, jewellery production, screen printing and vitreous enamelling amongst many other things. Our aim is to listen to the needs of our members and do our very best to offer them the resources to allow them all to develop their skills and fulfil their creative ambitions.



Laser Cutting

Laser cutting / engraving still proves to be one of the most useful and versatile processes, creating long waiting lists for inductions and use of the machines. A new, smaller desktop laser cutter was purchased to ease the demand on the original machine. This has worked perfectly, significantly reducing waiting times and allowing even more people to experience the benefits of this great piece of technology.

Members projects include etching leather, engraving eggs, cutting accurate acrylic cogs for a clock, constructing components for a home-made 3D printer and parts for a student built Formula 1 car.



Ceramics

Ceramics continue to be so popular that we found it essential to create a dedicated area to contain everything. Drawing on the expertise and experience of technician Zac and makespace manager Ellie we were able to craft a bench and storage area that generate an efficient work flow from wheel to kiln. This immediately helped to enable our members to use the facilities. We have also bought a second throwing wheel so that more people can throw pots at once.

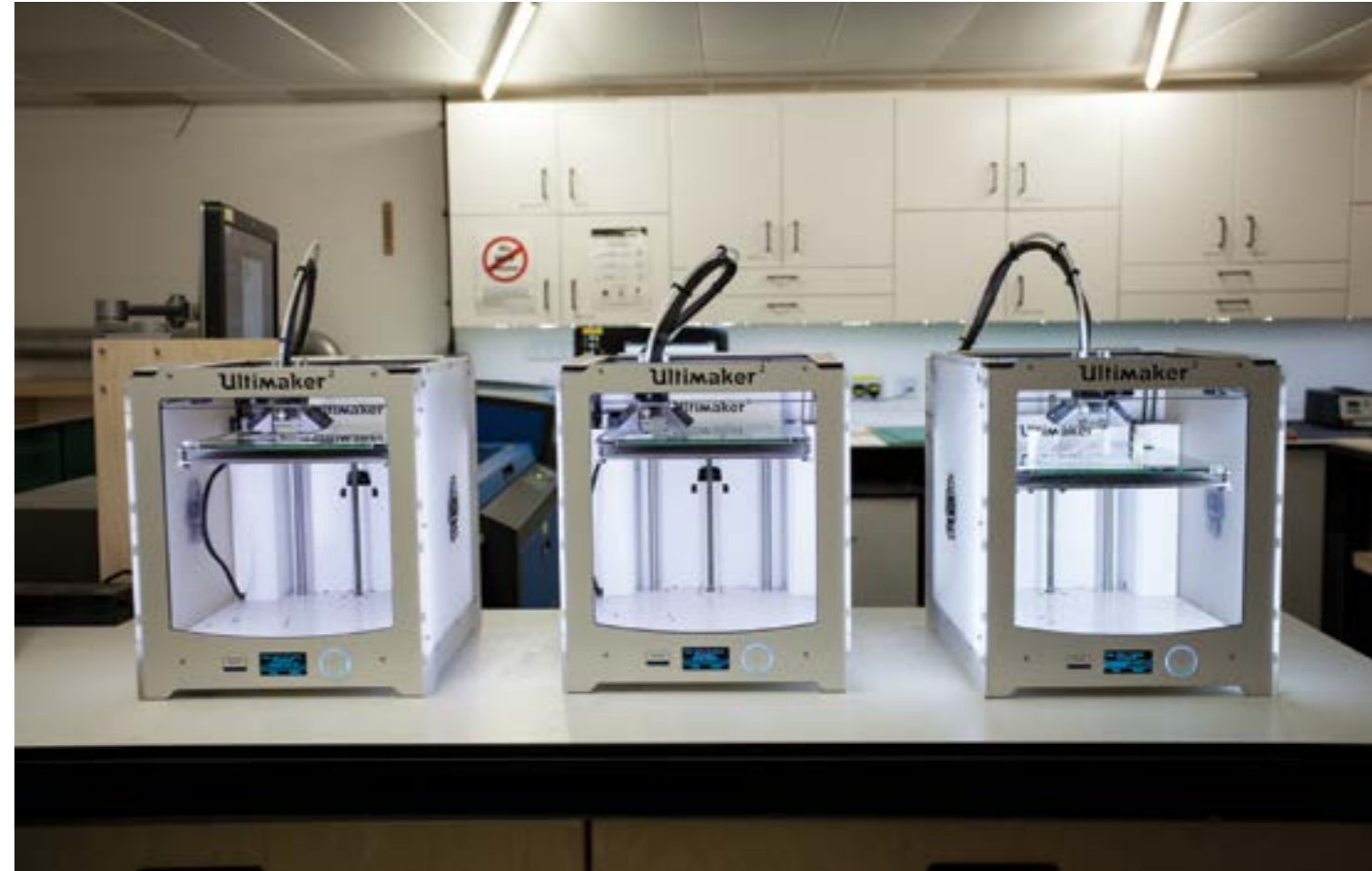
Members projects range from slip cast tea cups, architectural experiments, ceramic tools for a research project to coral-textured, blob-like forms for an art project.



3D Printing

3D printing was so popular in our first year that we managed to work the three printers to the end of their natural lives, to a point beyond reasonable repair. The decision was made to replace our ailing 3D printers with three Ultimaker 2 machines. The reliability and quality of these machines has meant our members have been able to print at a higher level of consistency. Not only that but our technicians Rich and Zac have needed to spend much less time repairing them, freeing up time to help more members use them. In year 3 we aim to expand our range of 3D printers to include the latest desktop technology with the acquisition of some Form 1 high resolution SLA resin 3D printers. These would offer a higher resolution and level of detail than we can currently print.

Members use the printers to print all sorts of things including scaled down architectural shapes, parts for a Formula 1 car and bespoke jewellery.



Woodworking

We have installed a suite of small scale Proxxon woodworking machinery with the purpose of building people's confidence one step at a time with potentially intimidating making processes. These tools include a table saw, chop saw, band saw, thicknesser planer, sander and router table and mean that members can learn the possibilities and risks of woodworking at a much smaller scale.

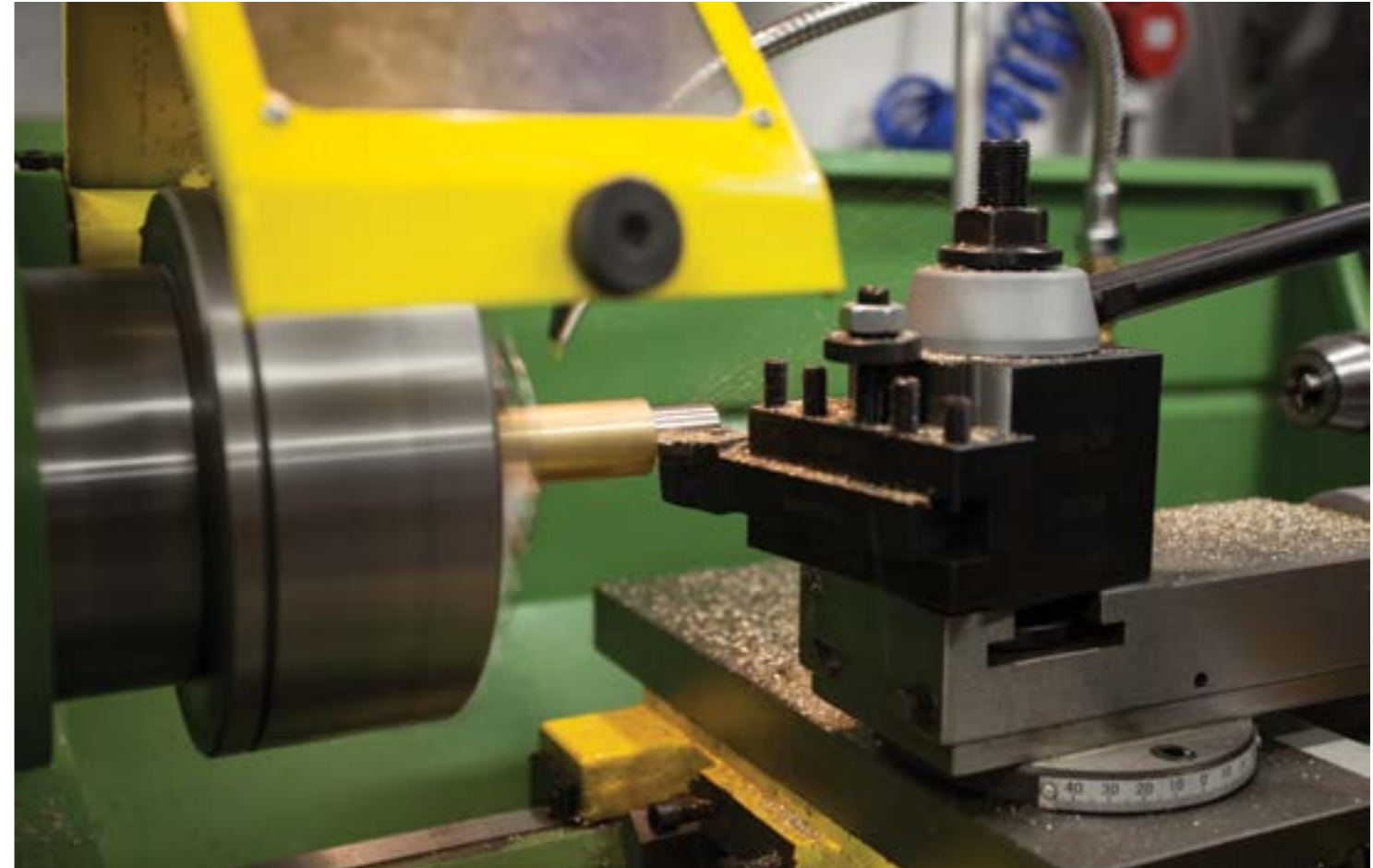
Members have made items such as a wardrobe, tables, boxes of all types, moulds for concrete casting and cabinets for speakers.

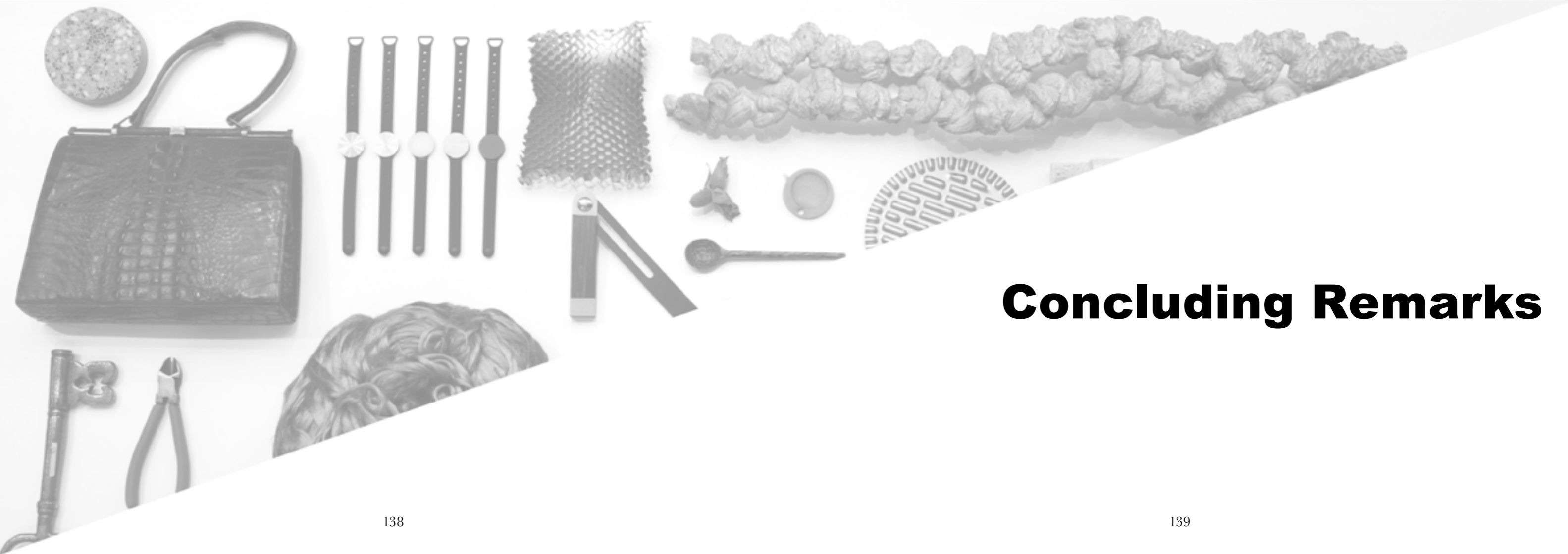


Metal Lathe

Another high-demand piece of equipment has been the engineering lathe. Being such a useful machine it's used by a wide variety of our members from all disciplines. Because of its popularity we decided to upgrade the existing lathe to a more accurate and robust model. The new lathe includes coolant and digital readouts, which opens up the possibility of using a wider variety of materials and the capability of machining components to a much higher tolerance. We are hoping over the next year this will enable our members to be even more ambitious, as well as being able to take their skill base to an even higher level. In the coming year we hope to do the same with the milling machine, which is another equally important machine in the workshop.

Members have used the lathe to make pulleys, cufflinks from bullets and modifications to lab equipment.





Concluding Remarks

“Although we have had two spin-out companies emerge from the Institute of Making, I am equally proud of the failures: they say a lot about our culture of uninhibited exploration and playful exuberance.”

(Mark Miodownik, Institute of Making, 2015)

The increase in our membership from 2616 people last year to more than 4000 this year is indicative of continuing huge demand for change in the way that universities operate. Traditional learning through lectures and library assignments will always have its place, but we are part of a growing body of evidence that a broader educational experience is needed. Students and staff don't just need some knowledge about other disciplines: they need some tangible experience of them, and to feel part of the intellectual community that is a university. This is what the Institute of Making essentially offers: a platform for self-development through making and materials interaction, and an invitation to be part of our multidisciplinary community through the events, research workshops, masterclasses and daily making of stuff in the workshop. This seems simple but it is extremely rare in universities and other educational establishments.

Our approach is particularly important in the context of knowledge-based economies because de-industrialisation has implicitly devalued making. This is a problem because making is not just an economic activity; it is the equal of literature, performance or mathematics as a form of human expression. By eschewing material knowledge we cease to understand the world around us. We wring our hands about climate change, urban sprawl, and running out of landfill sites without any recognition that it might be our ignorance of materiality that is the cause. We rightly feel proud of the technological marvel that is a smart phone, and yet we upgrade at the first

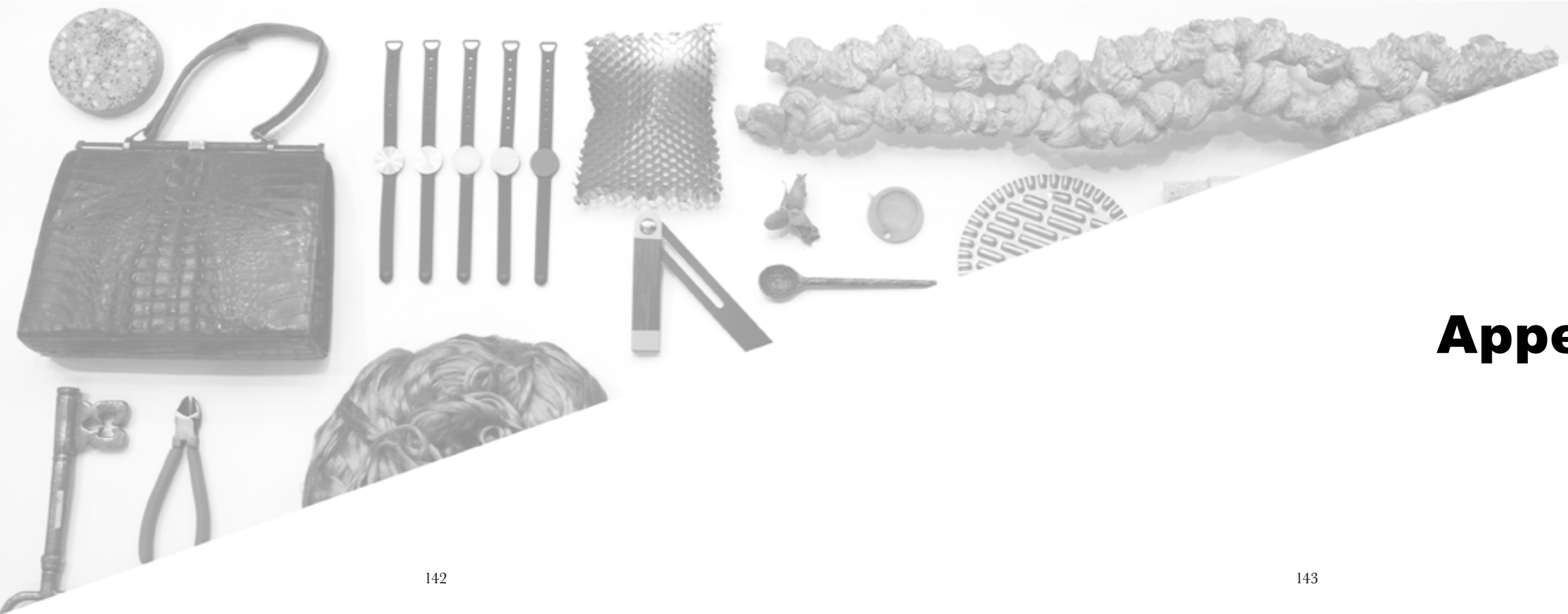


opportunity. We may assuage our conscience by hoping that they are recycled with some technology equal in sophistication to their fabrication techniques but they are not; most are disposed of in industrial blenders.

If we want to provide an education for the generation who need to address issues of deforestation, climate change, or economic stagnation, it is vitally important they understand, and know from experience, the value of making and materials. We offer a place to do this, free and open to all at UCL. It is a place of exploration, but also a place where failure is allowed and recognised as part of the learning process.

“The Institute of Making fizzles with potential; the potential of material, the potential of tools and the potential of our members. It is such a privilege to be able to nurture this and provide a really extraordinary facility for anyone at UCL to be part of. I'm really looking forward to where we go next.”

(Zoe Laughlin, Institute of Making, 2015)



Appendix

Summer Studentship Projects

Waxy Degeneration

Student: Edith Dormandy (History of Art)

Supervisors: Charles Ford (History of Art) and Karin Ruggaber (Slade)

Eliminating Flux Vortices in Quantum Superconducting Circuits and Silicon Chips

Student: Markos Karasamanis (Physics & Astronomy)

Supervisors: Dr Jarryd Pla (London Centre for Nanotechnology) and Dr Paul A. Barlett (Physics & Astronomy)

Bioreactor Design for Epithelial Sheet Production and Delivery

Student: Esmond Lee (Surgery & Interventional Science)

Supervisors: Dr Mark Lowdell (UCL Medical School) and Professor Chris Mason (Biochemical Engineering)

Modelling the Antikythera Mechanism

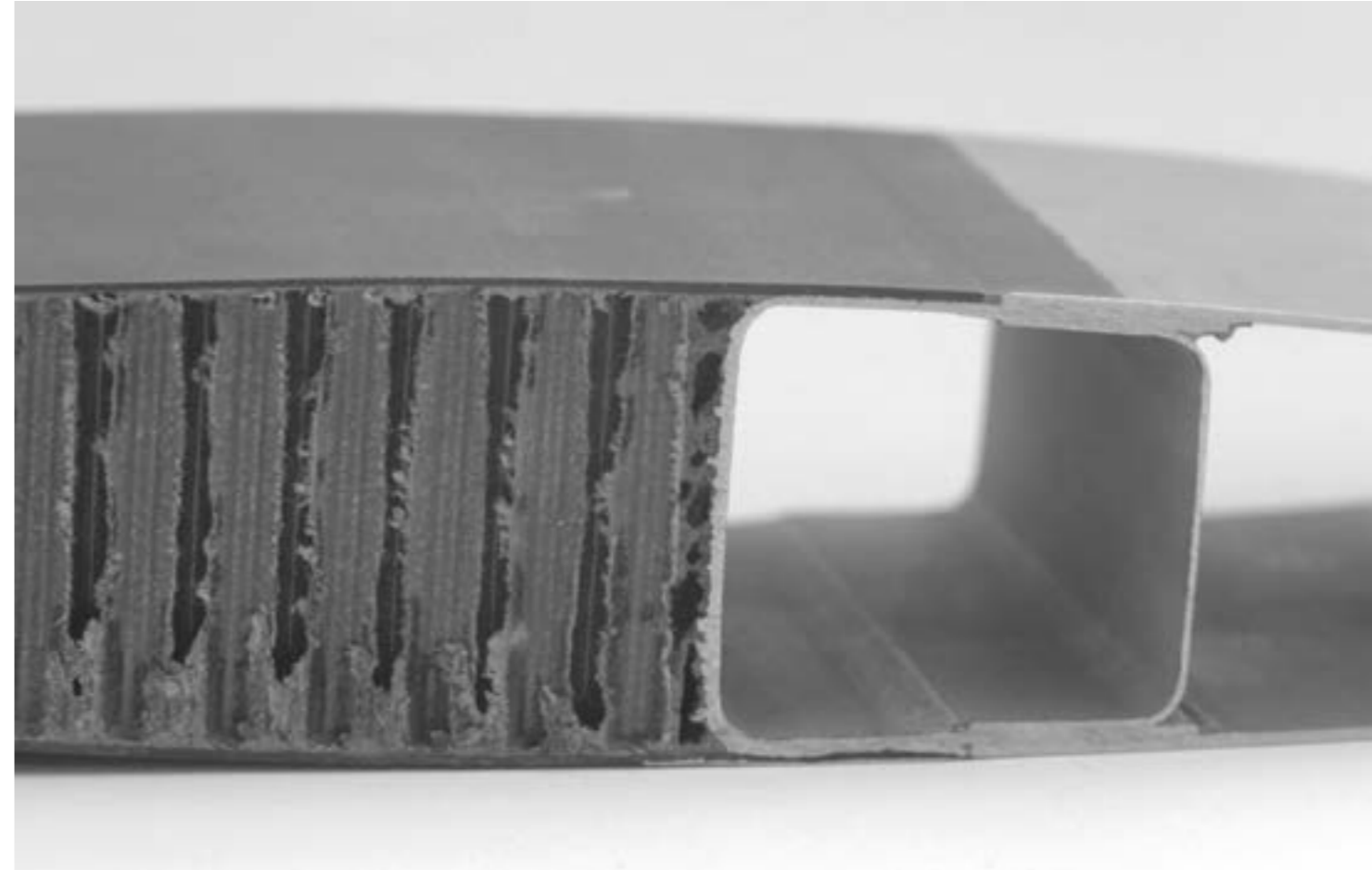
Student: Daniel Black (Geography)

Supervisors: Lindsay McDonald (Civil, Environmental & Geomatic Engineering), Dr Anson Mackay (Geography) and Tony Freeth (Antikythera Mechanism Project)

Making a 'Living' Replacement Aortic Valve

Student: Daniel Hardej (Mechanical Engineering)

Supervisors: Dr Gaetano Burriesci (Mechanical Engineering), Dr Ryo Torii (Mechanical Engineering), and Dr Vivek Mudera (Department of Surgical Sciences)



LEGO2NANO Team

UK Team

Students:

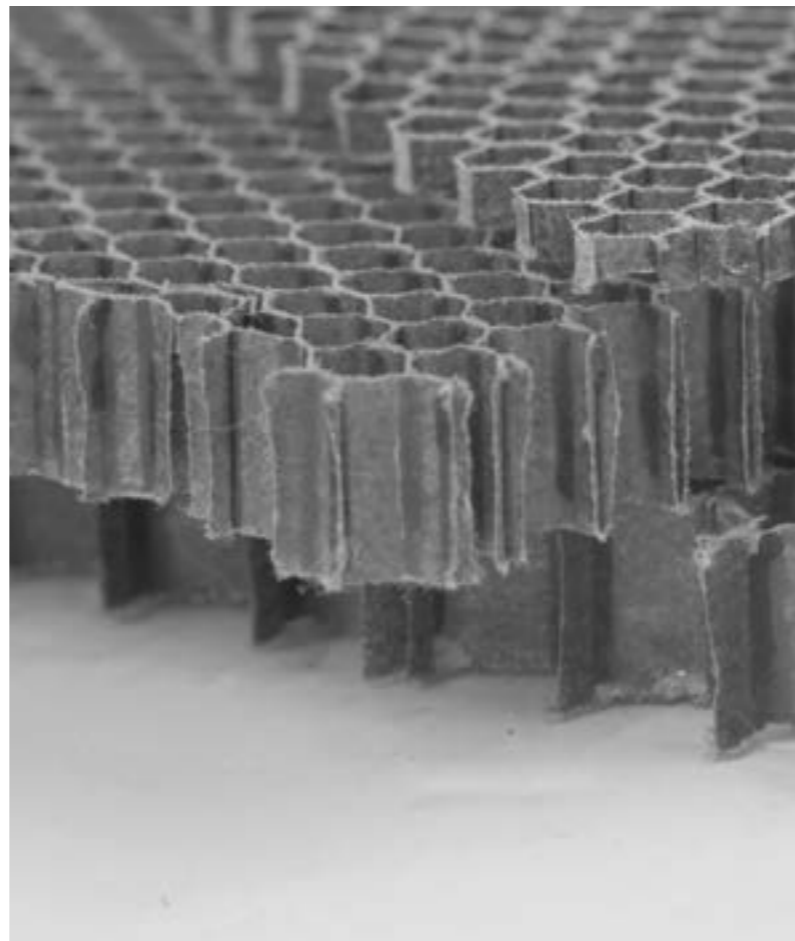
Jeffrey Shen, student, Engineering
Weng Chen, student, Engineering
Harmohan Sahota, student, Engineering
Tom Catling PhD Physics
Pavlos Apostopolis, student, LCN/Physics
Ming The, student, Engineering
Ben Miller, PhD student, LCN
Michael Wojcicki, student, Engineering
Antonia Miller, student, Engineering

Student mentors:

Alice Pyne, PhD student, LCN
Joe Bailey, PhD student, LCN

Staff:

Pavlo Zubko, LCN/Physics
Ellie Doney, Institute of Making
Elzerman Jeroen, LCN
James Lawrence, Engineering
Hidekazu Kurebayashi, LCN



China team

Students:

Xin Wen, student, Art & Design, Tsinghua University
Qinghua Shi, student, Art & Design, Tsinghua University
Nan Xiao, student, Art & Design, Tsinghua University
Meng Wang, student, Art & Design, Tsinghua University
Zheng Chen, student, Computer Science, Peking University
Fengyuan Zhu student, Physics, Peking University
Zhicong Lu, student, Art & Design, Tsinghua University
Yongzheng Wen, PhD student, Peking University
Wei Ma, PhD student, Peking University
Rui Zhao, PhD student, Peking University
Xiaofeng Gong, PhD student, Peking University

Staff:

Yingqing Xu, Academy of Arts & Design and Lifelong Learning Lab, Tsinghua University
Francois Grey, Lifelong Learning Lab, Tsinghua University
Xiaomei Yu, Institute of Micro and Nanotechnology, Peking University
Luping Xu, Open Wisdom Lab, Tsinghua University
Bingrui Tang, Psychology, Tsinghua University
Weipeng Kuang, Open Wisdom Lab, Tsinghua University
Zhifeng Tang, Open Wisdom Lab, Tsinghua University
Mengxing Qui, Academy of Arts & Design and Lifelong Learning Lab, Tsinghua

Materials Storeys Team

Professor Helen Storey, designer and social artist

Professor Kate Storey, biologist

Caroline Coates, project producer

Professor Mark Miodownik, materials scientist

Ellie Doney, Institute of Making, makespace manager

Students:

Bryony Benn, Civil, Environmental and Geomatic Engineering

Clair Chew, PhD student, Materials Chemistry

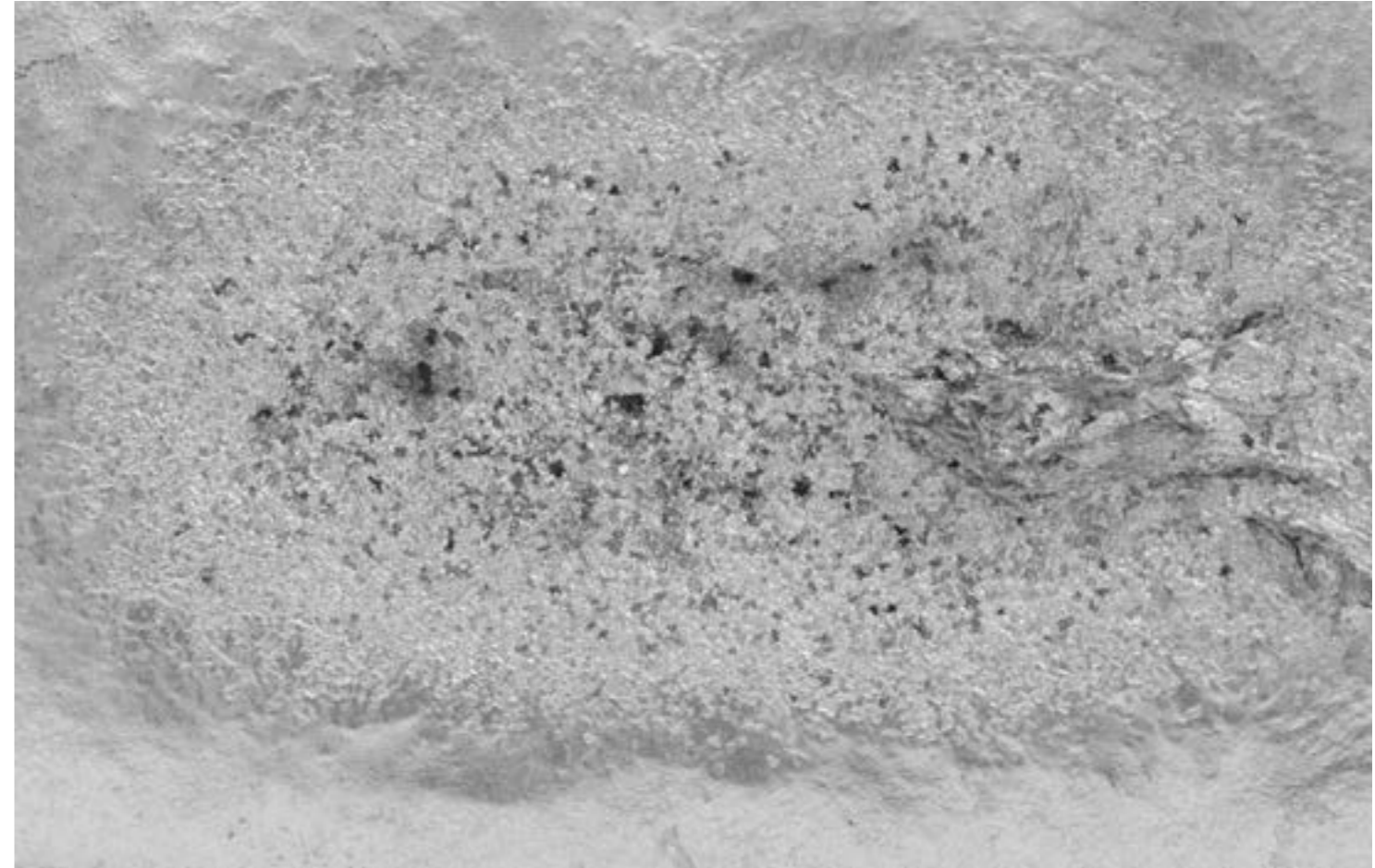
Lan Lan, Slade School of Fine Art

Emilia McLaughlin, Biosciences

Puja Bharadia, PhD student, Faculty of the Built Environment, Centre for sustainable heritage - Chemistry

Lucy Walmsley, Arts and Sciences

Rosita Bannert, Arts and Sciences



Small Research Grant Winners 2014

Cleaning Materials: Effects of Cleaning Materials and Maintenance on Whole Life Analysis of Manufactured Items

Investigators: Dr Kaori O'Connor (Anthropology), Prof Julian Evans (Chemistry), Dr Paola Lettieri (Chemical Engineering), Prof Susanne Kuechler (Anthropology)

Creating a Modular, Kinetic Octohedral Robot

Investigators: Ruairi Glynn (Bartlett School of Architecture) and Dr Peter Bentley (Computer Science)

Enacting and Re-enacting the Cast: Robot-Actuated Ceramic Casting

Investigators: Kate Davies (Bartlett School of Architecture), Emmanuel Vercruysse (Bartlett School of Architecture), Giles Corby (Slade School of Fine Art), Lilah Fowler (Slade School of Fine Art) and Prof Ed Allington (Slade School of Fine Art)

Nanomaterial-Based Sensors for Urban Environmental Monitoring

Investigators: Gwyn Evans (Security Science), Louise Francis (Civil Engineering), Dr Claire Ellul (Civil Engineering), Alistair Leak (Security Science), David Buckley (LCN), Prof Neil Skipper (LCN)

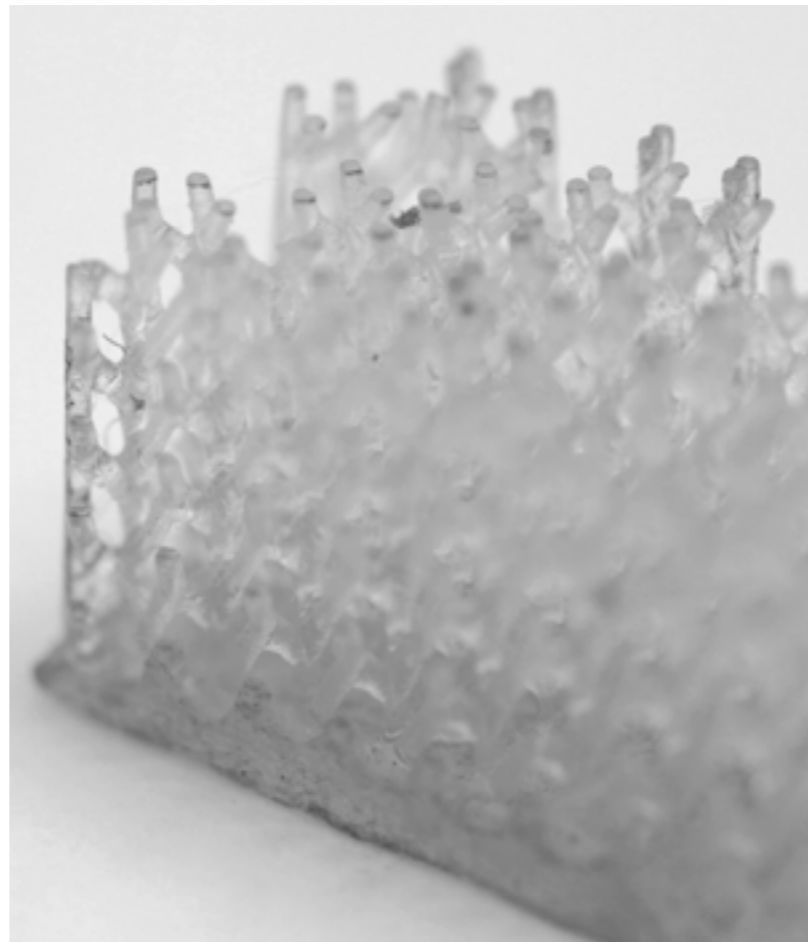
RF Sensor for Identifying Targets Using Micro-Doppler Signatures

Investigators: Dr Matthew Ash (Electronic & Electrical Engineering), Dr Matthew Richie (Electronic Engineering) and Dr Kevin Chetty (Security & Crime Science)



Staff Materials Bursary Recipients 2014

Alexia Sawyer	Making Small Social Spaces
Alice Salmon	A Woodwork Wedding
Anila Babla	Craft Rehab – Addicted to Craft
Charmian Dawson	Working Model of ATP Synthase
Elliott Magee	Pi Tablet V1.0
Erwin Alles	Laser Cut Ultrasonic Imaging Lenses
Gabrielle Anderson	Hand-Twisted Torc
George Konstantinou	Modular LED Video Wall
Guifen Chen	Convertible Bean Bag Chair
James Guggenheim & Bradly Treeby	Cigar Box Guitar and Bass Project
James Schwanethal	CO ₂ Laser Shield
Josephine McNally	Biowalls and Biosculptures
Judith Goddard	Mica and Light
Marco Endrizzi	X-Ray Phase-Contrast Imaging Phantoms
Maria Del Pilar Garcia Souto	Personalised Frames
Marina Konstantatou	Dovetail Sculptural Box
Michael Sulu	Recycling Process
Michele Barbeyto	Wonderland
Nick Bradbeer	Wireless Telepresence Sentry
Paul Southern	Platform for New 3D Printable Materials
Richard Jackson	Platform for New 3D Printable Materials
Saira Mian	New Skills and Designs for Jewellery
Sally Day	Science Inspired Jewellery



Sara Adhitya
Subhadra Das & Ling Chiu
Suzanne Ruddy
Venus Shum

A 3D Multi-Sensorial Logo for UCL²
Forecast, Recast
Molecular Biosciences Achievement Medals
CodeMe: Tools for Educational Programme

Full List of Events

69 total events: 39 member events and 30 public events, including 32 masterclasses, 15 research events, 4 Materials Library evenings, 4 corporate events, 3 outreach events, 3 big public open days, 3 week-long events, 2 factory visits and 1 talk.

10th March, 2014. *Dinner with Picasso: The Unspoken Language of Food* (Research Hub event).

17th March, 2014. *Dinner with Picasso: Cheese - Embracing Entropy* (Research Hub event).

25th March – 28th March, 2014. *Art of Measuring Week* (Members event).

31st March, 2014. *Closed Loop Recycling* (Factory tour) Members event.

31st March, 2014. *Dinner with Picasso: Five Ways with Algae* (Research Hub event).

5th April, 2014. *Hat Over Heels* (Outreach).

7th April, 2014. *Dinner with Picasso: Green Eggs and Ham* (Research Hub event).

28th April, 2014. *Materials Histories: Emotions* (Research event).

5th May, 2014. *Dinner with Picasso: An Oulipean Wine-Tasting* (Research Hub event).

12th May, 2014. *Material Histories: Restorations* (Research event).

19th May, 2014. *Atkins* (Corporate event).

2nd June, 2014. *Materials and Society Conference* (Research event).

4th June, 2014. *3D Scanning with Mona Hess* (Masterclass) Members event.

6th June, 2014. *Raku Firing – Petrie Musuem Festival of Pots* (Members event).

9th June, 2014. *Low-Cost 3D Scanning with Jan Boehm* (Masterclass) Members event.

17th June, 2014. *Morning session-Felt Making Masterclass* (Festival of Stuff) Public event.

17th June, 2014. *Morning session-Millinery Masterclass* (Festival of Stuff) Public event.



17th June, 2014. *Morning session-Soap Making Workshop* (Festival of Stuff) Public event.

17th June, 2014. *Afternoon session-Felt Making Masterclass* (Festival of Stuff) Public event.

17th June, 2014. *Afternoon session-Millinery Masterclass* (Festival of Stuff) Public event.

17th June, 2014. *Afternoon session-Soap Making Workshop* (Festival of Stuff) Public event.

18th June, 2014. *Arduino for Beginners Masterclass* (Festival of Stuff) Public event.

18th June, 2014. *Animatronics Masterclass* (Festival of Stuff) Public event.

18th June, 2014. *Session one-Materials Library Evening* (Library) Public event.

18th June, 2014. *Session two-Materials Library Evening* (Library) Public event.

19th June, 2014. *Session one-Blacksmithing Masterclass* (Festival of Stuff) Public event.

19th June, 2014. *Session two-Blacksmithing Masterclass* (Festival of Stuff) Public event.

19th June, 2014. *Session three-Blacksmithing Masterclass* (Festival of Stuff) Public event.

20th June, 2014. *Morning session-Spoon Carving Session* (Festival of Stuff) Public event.

20th June, 2014. *Morning session-Wood Turning Masterclass* (Festival of Stuff) Public event.

20th June, 2014. *Midday session-Spoon Carving Session* (Festival of Stuff) Public event.

20th June, 2014. *Afternoon session-Wood Turning Masterclass* (Festival of Stuff) Public event.

20th June, 2014. *Afternoon session-Spoon Carving Session* (Festival of Stuff) Public event.

30th June, 2014. *Festival of Stuff* (Open day) Public event.

14th July, 2014. *E-Fibre: Material Engagement* (Research Hub event)

21st July – 25th July, 2014. *Luted Crucible Bronze Casting Week* (Masterclass) Members event.

4th August, 2014. *Session one-The World as a Materials Library* (Outreach)

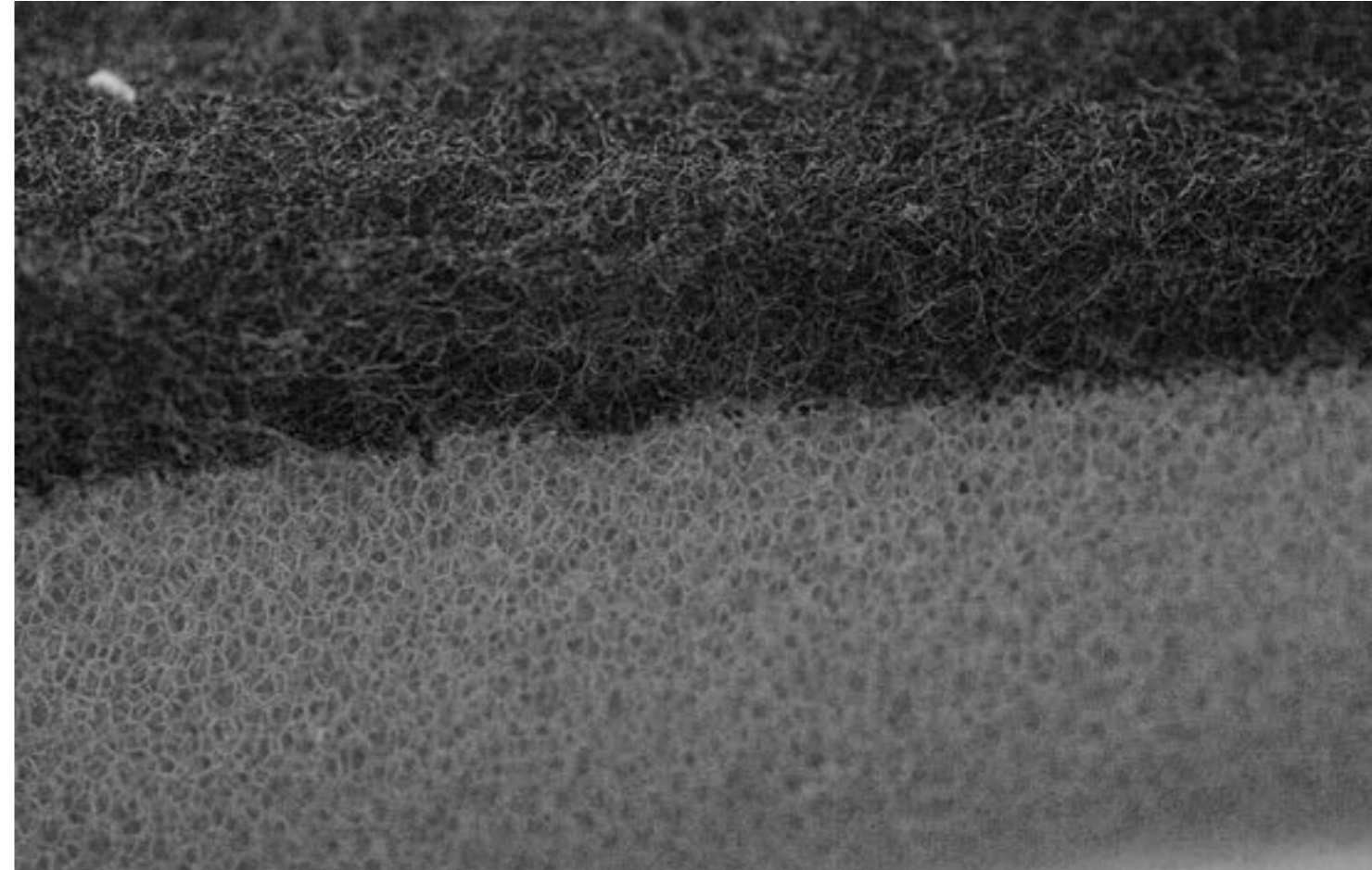
4th August, 2014. *Session two-The World as a Materials Library* (Outreach)

18th September - 20th September, 2014. *Pop Up Pop Up*. (Research Hub event)

29th September, 2014. *Dinner with Picasso: Final Workshop* (Research Hub event).

30th September – 3rd October, 2014. *Robots Week* (Open to all UCL).

1st October, 2014. *Experimental Laser Cutting* (Masterclass) Members event.
1st October, 2014. *CNC Milling* (Masterclass) Members event.
2nd October, 2014. *Animatronic Eye Making* (Masterclass) Members event.
2nd October, 2014. *Arduino Animatronic Eye* (Masterclass) Members event.
3rd October, 2014. *CNC Milling* (Masterclass) Members event.
3rd October, 2014. *The History of Robots with Iain Duncan* (Talk) Members & Public event.
13th October, 2014. *Selex* (Corporate event).
27th October, 2014. *Ford* (Factory tour) Members event.
27th October, 2014. *Health, Safety & Creativity* (Research event).
30th October, 2014. *Materials Library Evening* (Library) Public event.
5th November, 2014. *Arduino with Mark Handley* (Masterclass) Members event.
12th November, 2014. *Arduino with Mark Handley* (Masterclass) Members event.
21st November, 2014. *Pencil Making* (Masterclass) Members event.
21st November, 2014. *Pencil Making* (Masterclass) Public event.
22nd November, 2014. *Carbon* (Open day) Public event.
1st December, 2014. *R&A - Making Matters* (Corporate event).
8th December, 2014. *Pyrotechnics with Matthew Tosh* (Research event).
10th December, 2014. *The Great Robot Egg Race* (Members challenge) Members event.
15th December, 2014. *Nottingham Trent University* (Corporate event).
26th January, 2015. *Hidden Histories of Things* (Research event).
29th January, 2015. *Morning session-Basket Weaving* (Masterclass) Members event.
29th January, 2015. *Afternoon session-Basket Weaving* (Masterclass) Members event.
9th February, 2015. *Shaker Box Making* (Masterclass) Members event.
16th February, 2015. *Morning session-Sugar Glass* (Masterclass) Members event.
16th February, 2015. *Afternoon session-Sugar Glass* (Masterclass) Members event.
17th February, 2015. *Materials Library Evening* (Library) Public event.
7th March, 2015. *Metal* (Open day) Public event.



Institute of Making Publications

Conreen, M., Laughlin, Z. and Miodownik, M. 2007. Strange Material. *Proceedings of Ars Ornata Europæana*, Manchester.

Hashimdeen, S. H., Miodownik, M., & Edirisinghe, M. J. 2014. The Design and Construction of an Electrohydrodynamic Cartesian Robot for the Preparation of Tissue Engineering Constructs. *PLoS One* 9(11), e112166. doi:10.1371/journal.pone.0112166

Hashimdeen, S. H., Miodownik, M., & Edirisinghe, M. J. 2013. Print Head Design and Control for Electrohydrodynamic Printing of Silk Fibroin. *Materials Science and Engineering C* 33(6), 3309-3318. doi:10.1016/j.msec.2013.04.020

Howes, P. D., Wongsriruksa, S., Laughlin, Z., Witchel, H. J., & Miodownik, M. 2014. The Perception of Materials Through Oral Sensation. *PLoS One* 9(8), e105035. doi:10.1371/journal.pone.0105035

Howes, P. and Laughlin, Z. 2012. *Material Matters: New Materials in Design*. Black Dog Publishing, London. ISBN:978-1907317736

Laughlin, Z., Naumann, F. and Miodownik, M. 2008. Investigating the Acoustic Properties of Materials with Tuning Forks. *Materials & Sensations Pau* (France) Oct. 22-24.



Laughlin, Z., Naumann, F., Conreen, M., and Miodownik, M. 2009. Investigating the Acoustic Properties of Materials with Tuning Forks. *Proceedings of the MINET Conference: Measurement, Sensation and Cognition* 10-12 Nov. pp. 124-126. National Physical Laboratory, London.

Laughlin, Z., Conreen, M., Witchel, H. and Miodownik, M. 2009. The Taste of Materials: Spoons. *Proceedings of the MINET Conference: Measurement, Sensation and Cognition* 10-12 Nov. pp. 127-128. National Physical Laboratory, London.

Laughlin, Z. 2010. *Beyond the Swatch: How can the Science of Materials be Represented by the Materials Themselves in a Materials Library?* PhD Thesis, King's College London.

Laughlin, Z., Conreen, M., Witchel, H. J. and Miodownik M. 2011. The Use of Standard Electrode Potentials to Predict the Taste of Solid Metals. *Food, Quality and Preference* 22(7) pp. 628-637.

Laughlin, Z. 2013. Jenseits des Musters: Forschung in der Materials Library. In Peters, S. (eds) *Das Forschen Aller: Artistische Reserach als Wissensproduktion zwischen Kunst, Wissenschaft und Gesellschaft*. (The Research of All: Artistic Research as Knowledge-Production between Art, Science and Society). pp. 121-140, Transcript Verlag, Germany. ISBN: 978-3-8376-2172-3

Laughlin, Z. and Howes, P. 2014. The Sound and Taste of Materials. In Karana, E., Pedgley, O. and Rognoli, V. (eds.). *Materials Experience: Fundamentals of Materials and Design*. pp. 39-49. Butterworth-Heinemann, Oxford. ISBN: 978-0-08-09359-1

Miodownik, M. 2007. Toward Designing New Sensoaesthetic Materials. *Pure Applied Chemistry* 79(10) pp. 1635-1641.

Miodownik, M. 2009. *Materials in the Creative Industries*. Materials UK. Available at: <http://www.matuk.co.uk/docs/MaterialsUK-CreativeIndustries.pdf>

Miodownik, M. 2013. *Stuff Matters: The Strange Stories of the Marvellous Materials that Shape Our Man-made World*. Penguin Books, UK. ISBN: 9780670920549.

Miodownik, M. 2013. The Institute of Making. *Materials Today* 16 pp. 458-459.

Piqueras-Fizman, B., Laughlin, Z., Miodownik, M. and Spence, C. 2011. Tasting Spoons: Assessing How the Material of a Spoon Affects the Taste of the Food. *Food, Quality and Preference* 22(7) pp. 628-637.

Wilkes, S. 2011. Materials Libraries as a Vehicle for Knowledge Transfer. *Anthropology Matters* 13(1). Available at: www.anthropologymatters.com

Wilkes, S. 2014. *In Search of Sustainable Materials: Negotiating Materiality and Morality in the UK Materials Industry*. PhD Thesis, University College London.

Wilkes, S. forthcoming 2015. Sustainability and the Co-Constitution of Substances and Subjects. In Kuechler, S. and Drazin, A. (eds.), *Materials Transformations: Anthropological Accounts of Materials and Society*. Bloomsbury, London.



Wilkes, S., Wongsriruksa, S., Howes, P., Gamester, R., Witchel, H., Conreen M., Laughlin, Z. and Miodownik, M. forthcoming 2015. Design Tools for Interdisciplinary Translation of Material Experiences. *Materials & Design Special Issue: Emerging Material Experiences*.

Wongsriruksa, S., Howes, P., Conreen M. and Miodownik, M. 2012. The Use of Physical Property Data to Predict the Touch Perception of Materials. *Materials & Design* 42 pp. 238-244.

Media Coverage

Newspapers

How Looking Through Glass Made Us View the World in a Different Light.
The Observer, Feb 2014

Concrete: Solid, Dependable, Obstinate – and Self-Healing. The Observer, Jan 2014

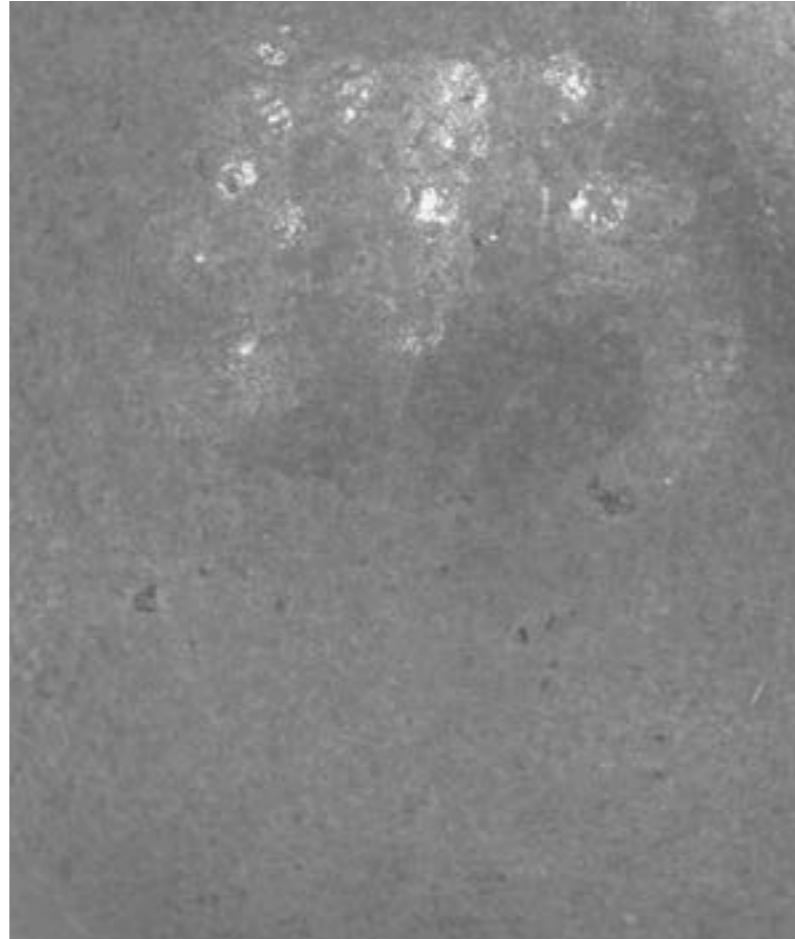
Don't Write-Off Paper: It's Got Human Knowledge All Wrapped Up. The Observer,
Dec 2014

Superalloys to the Rescue: The Marvellous Materials That Take Us To the Skies.
The Observer, Nov 2014

The Magic of Rubber: Irreverent, Sexy, Sporty Revolutionary...Indispensable.
The Observer, Oct 2014

Perfectly Imperfect Silicon Chips: The Electronic Brains That Run the World,
The Observer, Sept 2014

Why the Story of Materials Is Really the Story of Civilisation, The Observer, Sept
2014



Spoon Me: How Cutlery Design Can Blow Your Tastebuds Away, The Guardian,
Jan 2015.

Television and Radio

Anatomy of an Impact, Sky At Night, BBC4, June 2014.

Do We Throw Away Too Much Stuff?, Newsnight, BBC2, July 2014.

Private Passions, BBC Radio 3, Aug 2014

The Kitchen Cabinet, BBC Radio 4, Jan 2015.

Everyday Miracles: The Genius of Sofas, Stockings and Scanners, BBC4, Jan 2015.

BBC Breakfast, BBC1, Feb 2015.

The Today Programme, BBC Radio 4, Feb 2015.

Institute of Making Member Supervisors

Daniel Ashworth - Mechanical Engineering

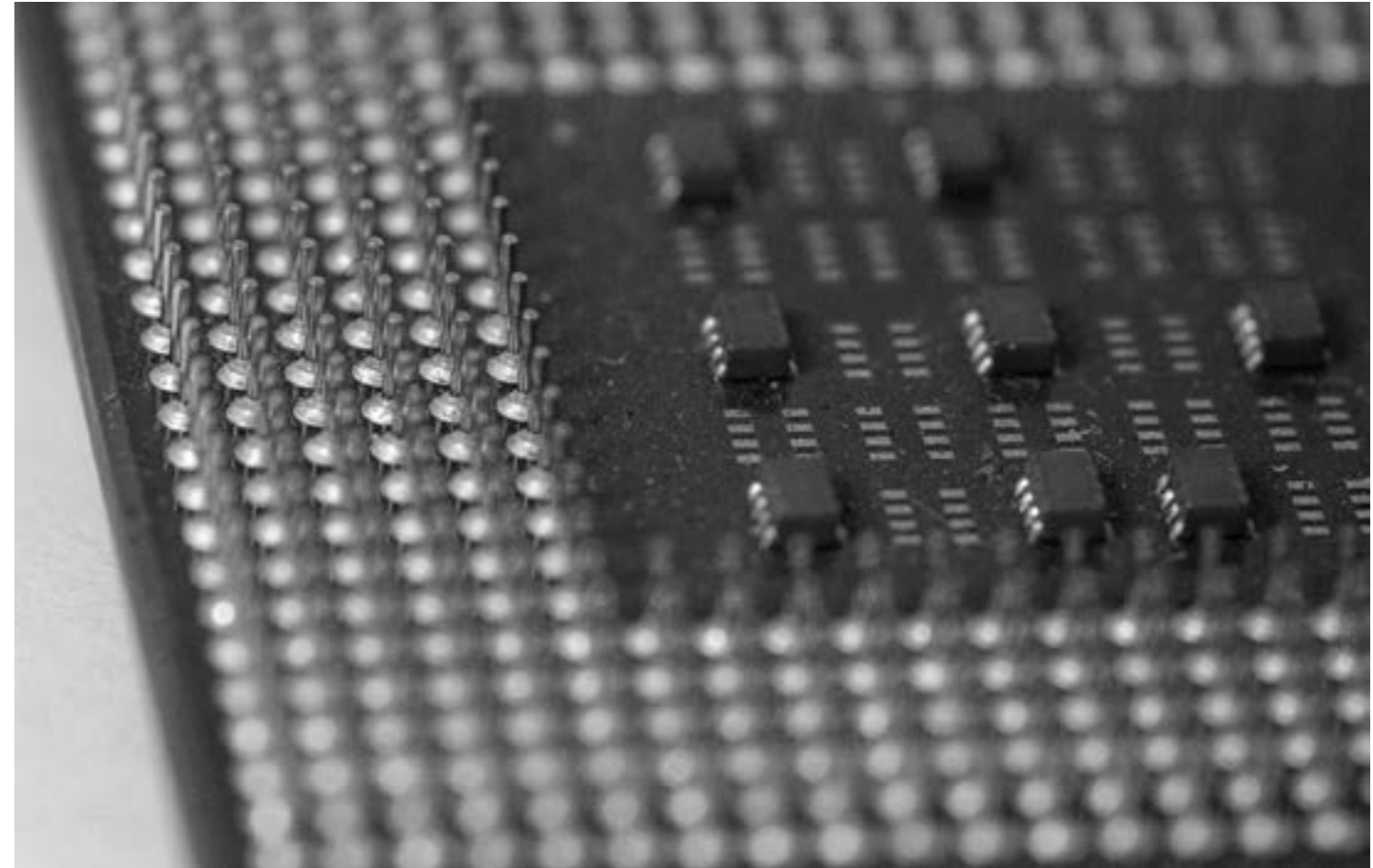
Elliott Magee - Medical Physics

Emilia McLaughlin - Life Sciences

Laura Dempsey - Medical Physics

Laure Durand - School of Architecture

Tom Catling - Physics and Astronomy



Birthday Award Winners

Outstanding Maker Award

Perseverance Award

The Spirit of the Makerspace

Head Turner

Most Experimental

Attention to Detail

Public Engagement

Most Helpful Member of Staff

Master of Masterclasses

Development Award

Most Prolific

Jack Reynolds

David Dukto

Laura Dempsey

Daniel Black

Nai-Rung Huang

Daphne Morgado

Emilia McLaughlin

Peter Kelly

Ben Oldham

Jack Lee

Wiktoria Kidziak



The Institute of Making Team

Ellie Doney – Makespace Manager

Elizabeth Corbin – Materials Library Assistant and PhD Student

Martin Conreen – Director of Making

Mark Miodownik – Director

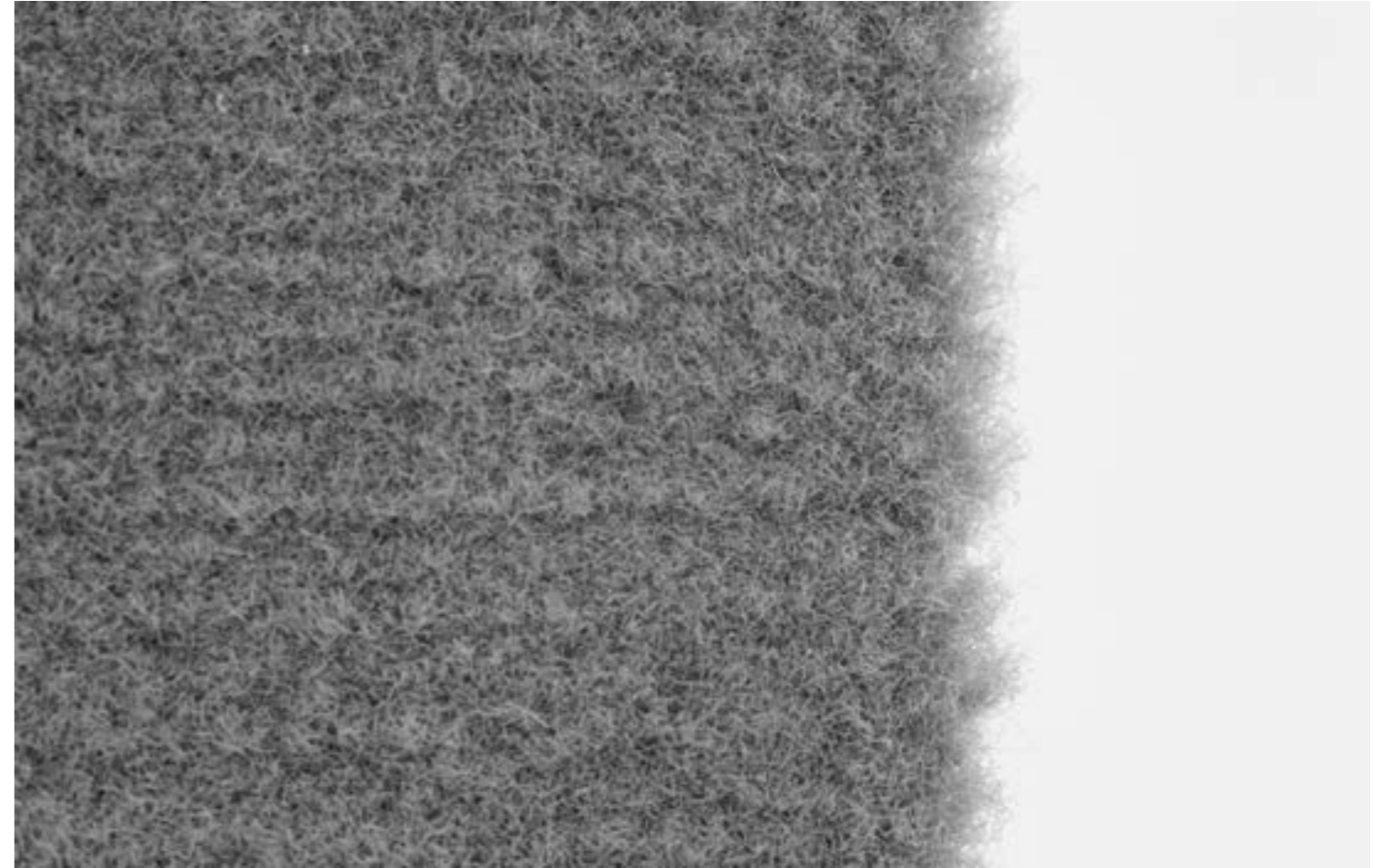
Olivia Alice Clemence – Events Coordinator

Richard Gamester – Makespace Technician

Sarah Wilkes – Research Manager

Zach Eastwood-Bloom – Assistant Makespace Technician

Zoe Laughlin – Creative Director



Steering Committee

Andrea Sella – Professor of Inorganic Chemistry, UCL

Anthony Finkelstein – Dean of Engineering Sciences and Professor of Software Systems Engineering, UCL (Chair)

Bob Sheil – Professor of Architecture and Design through Production, and Head of the Bartlett School of Architecture, UCL

Chris Wise – Expedition Engineering and Professor of Civil Engineering Design, UCL

Mark Handley – Professor of Networked Systems, Computer Science, UCL

Susan Collins – Director, Slade School of Fine Art, UCL

Susanne Kuechler – Head of Anthropology, Professor of Material Culture, UCL



Funding, Donations & Commercial Support

Alan Brener
AHRC
Atkins
Chris Nolan
Emma Thomas
EPSRC
European Union
Jeremy Anderson
Leverhulme Trust
Robert Nichols
UCL Engineering
Wellcome Trust



Full Statistics of Membership

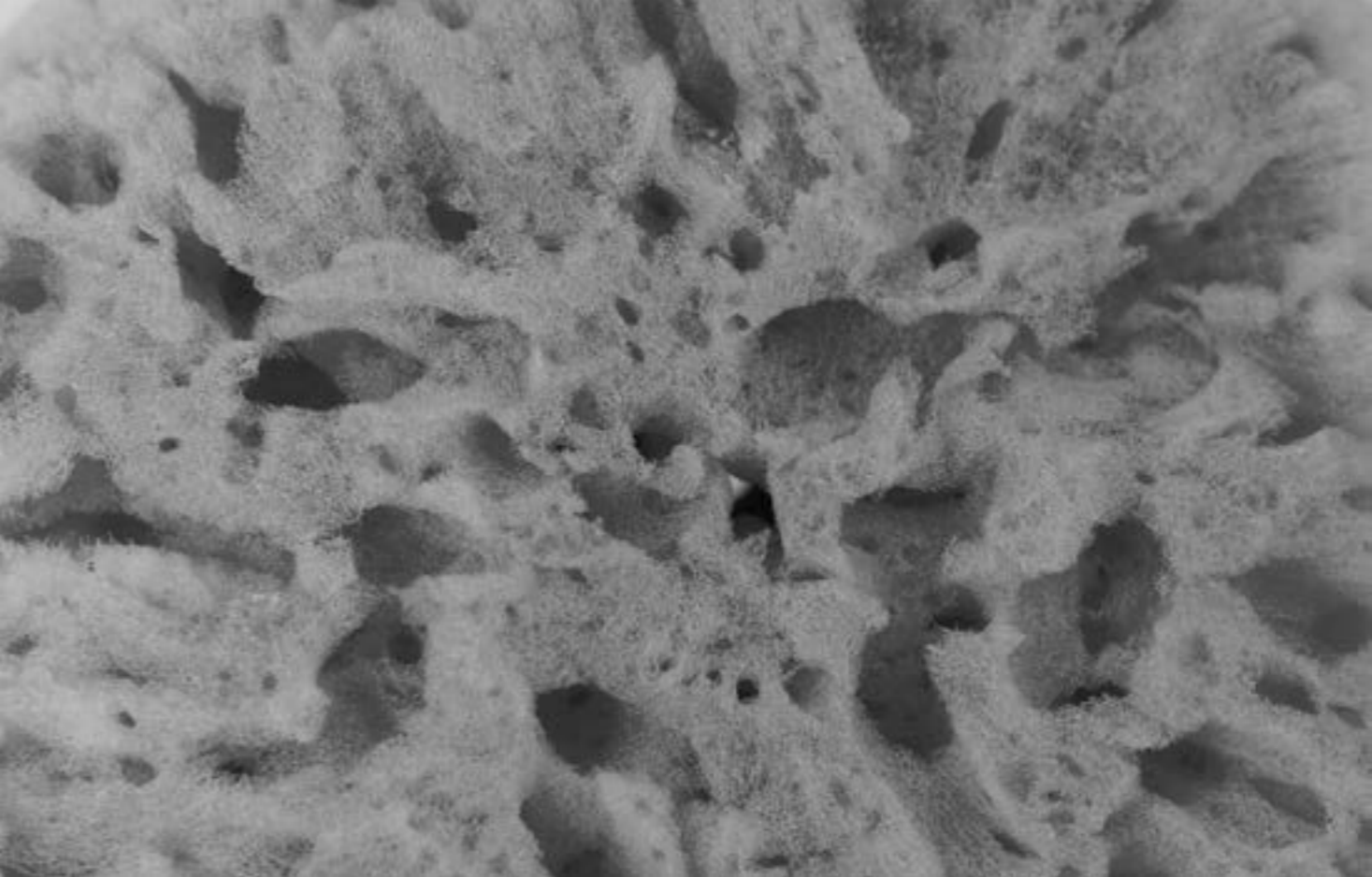
Membership Breakdown

Current Total 4479
Graduated 574

Gender
Female 46%
Male 47%
No gender declaration 7%

Member Type
Staff 22%
Academic Staff 13%
Professional Services Staff 7%

Students 78%
Undergraduate Students 42%
Postgraduate Students 36%



Thanks

Alan Brener
Alan Philcox
Andrea Sella
Andres Tretiakov
Andy Minnis
Angela Clemo
Angharad Milenkovic
Anna Clark
Anthony Finkelstein
Bob Sheil
Brendan Bryne
Chris Wise
Christine Simms
Christopher Nolan
Diane Davis
Elaine Briggs
Elpida Makrygianni
Emma Thomas
Gaurav Sharma
Giles Corby
Graeme McPhillips
Hannah Umar
Hassan Osman

Hayley Midwinter
James Keith
James Lawrence
Janic Nielsen
Jeremy Anderson
John Stewart
Katherine Fletcher
Lee Wilkinson
Leonie Hannan
Liz Walker
Lori Manders
Marina Stephanides
Mark Handley
Michael Arthur
Mike Dawe
Miranda Laughlin
Peter Kelly
Phil Howes
Prashanthan Ganeswaran
Rob Nichols
Rosie Meredith
Saffron Hutt
Sam Green



Sara Collins
Sarah Mackay
Sarah Richey
Simon Werrett
Susan Collins
Susanne Kuechler
Thea Sherer
Tom Hamer
Tom Kile Hartshorn
Tony Lawler

I thought it was fantastic fun and very educational in a non threatening way. People were telling each other about carbon. I started in the coal mining industry and was surprised to see a large block of anthracite at the opening. The guys from Cambridge illuminated carbon nanotubes for me and the whole event felt inclusive and vibrant.

My ex student Rob Buck (Chemistry at UCL) was inspired to want to join up so I think you have at least one new recruit and for myself I felt moved to retry and forge links with the art and photography dept which I have let go due to the time pressures we spoke about.

As I left I watched a young boy watching the fizzy drinks show, the look on his face was a pleasure to behold. I reckon one more scientist there at least. Anyway well done for setting it up - truly inspirational.

Best wishes, John Luton.



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