SPECULATIVE FUTURES

ARTWORK INFORMATION

STEPH TUDOR

THE INSTITUTE FOR SUSTAINABILITY

SPECULATIVE FUTURES

UTOPIAN VISIONING

The future is *plural* - there is no one future, there is an infinite landscape of possible futures. This can provide space to creatively imagine just a handful of the speculative futures ahead of us.

'Utopianism' can be used as a tool to expand creative thought when imagining a better future, and reflecting on different sensory aspects can help to deepen our connection to possible futures.

"Utopia should be understood as a method rather than a goal"
Ruth Levitas, Sociologist

"We have to think of utopias as a glimmer, a fleeting horizon, as a space that needs to be adjusted and readjusted. It can't ever be imagined as a static place, somewhere we simply arrive at - it is a process… Utopia as a concept provides a certain type of horizon for us to imagine, think about, feel, and touch. "
Alex Zamalin (Black Utopia)

T H E D A T E I S 2 0 7 3

The Institute for Sustainability has played an important role in the development and implementation of sustainable technologies. Many of the solutions that we benefit from today were conceived over 50 years ago. The result of these now fully embedded technologies is a cleaner, more sustainable and equitable landscape, both socially and environmentally.

This exhibition is a snapshot in time of this speculative landscape - the work displayed is part 'future artefact', part sculpture, part non-sensical object.

FILTRATION VESSELS

FILTRATION VESSELS

The UK still sees heavy downpours in winter, and droughts in the summer. Whilst plans are a-foot to modernise our water systems to ensure efficient use of grey water and rainfall, a de-centralised movement has sprung up among communities. Citizens are now well accustomed to rain water harvesting, and sustainability researchers and designers have worked together to create various water filtration vessels that can be used at home.

Some use photocatalytic membrane technology where high surface areas and UV from sunlight are utilised, others use pyroelectric technology with porous ceramics, and others use the ancient method of using reeds to filter water.

ENERGY + WATER // PROCESSES + MANUFACTURING

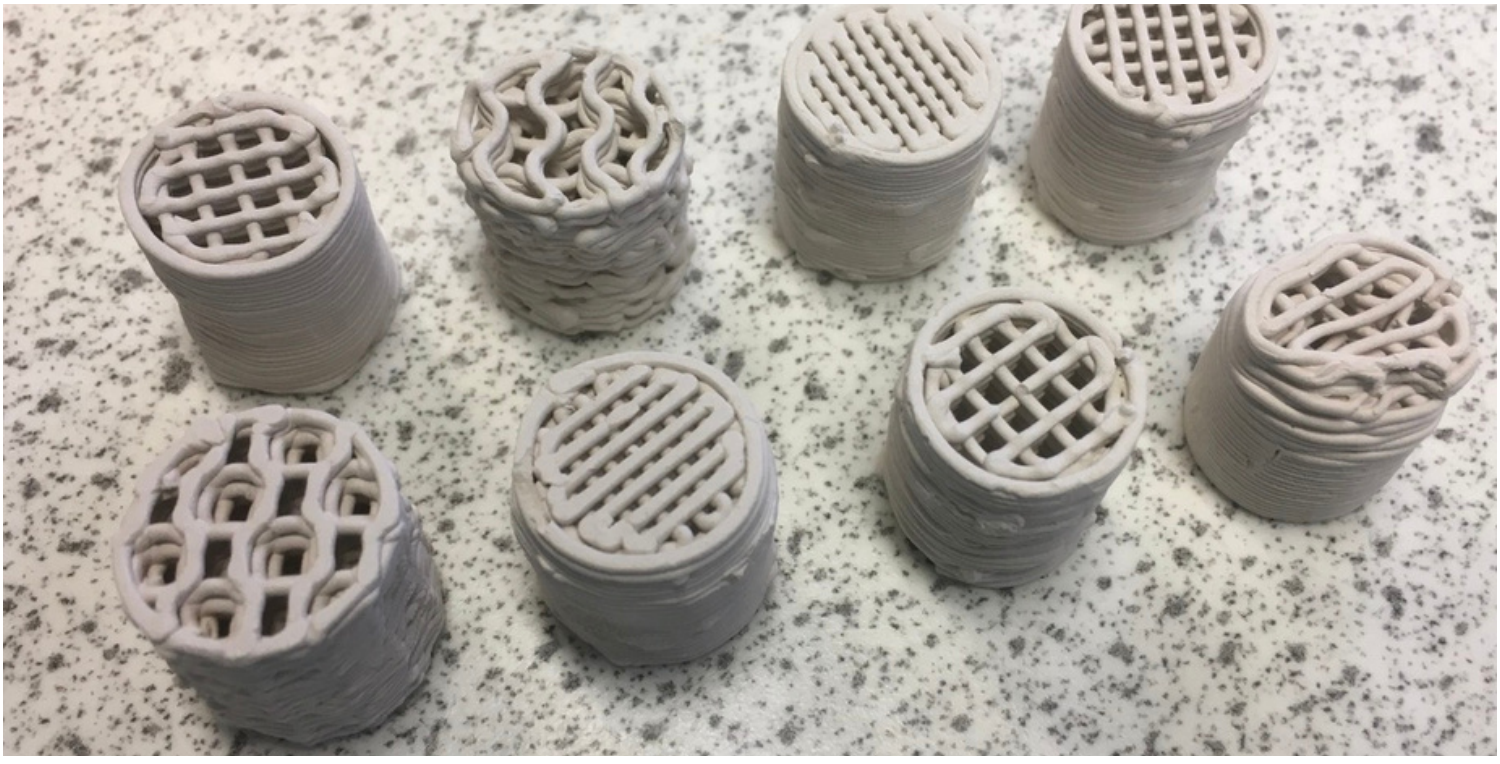
FILTRATION VESSELS

RESEARCHER INFORMATION

Photocatalysts have been shown to be able to breakdown pollutants present in water sources, providing a pathway towards safe drinking water free from pollution. When light shines on the surface of these materials, electrons become separated and can generate reactive species which are able to destroy pollutants to harmless compounds, a process called photocatalysis. Our structures are first 3D printed and then sintered, allowing us to precisely design the shapes we want to provide high surface area for illumination and reaction to occur at.

Synthetic membranes can be used to filter polluted water, by acting as a barrier that allows clean water to pass through whilst blocking pollutants, such as particles. Over time, a layer of material builds up on the membrane surface; this unwanted phenomenon is called fouling. 3D printing can be used to produce ceramic membranes in unusual shapes, for example having a wavy surface. Such surfaces promote mixing of the water near the membrane surface and reduce the effects of fouling, improving the efficiency of the filtration process."

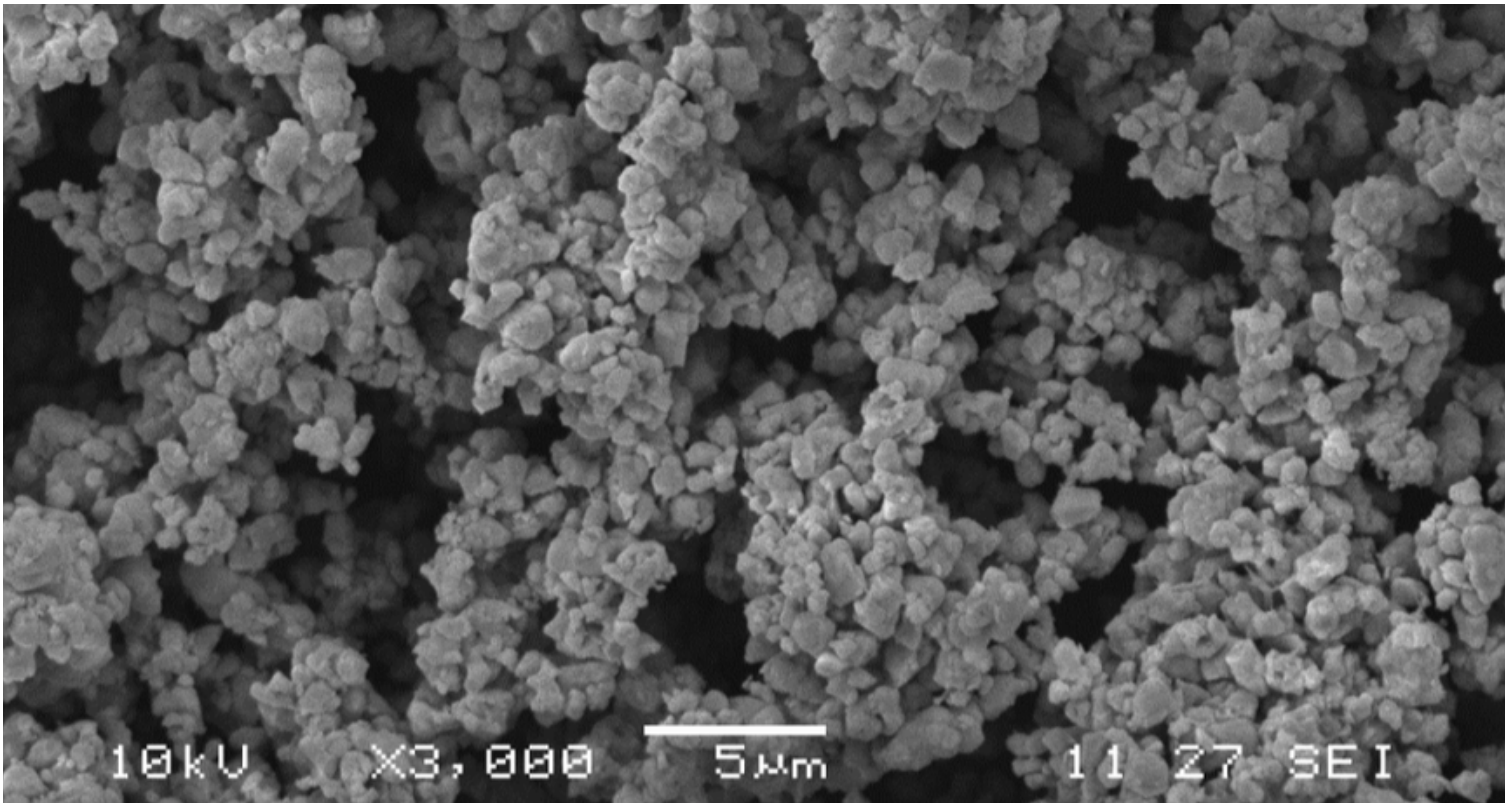
LIANA ZOUMPOULI // ZACHARY WARREN //
ALLYSON MARTIN



"Freeze casting is a process used for creating porous structures from ceramic powders. The powder is mixed with a small amount of binder and water, then ball-milled for 24 hours. The slurry is placed in a mould then frozen using liquid nitrogen. The ice crystals are removed by sublimation in a freeze dryer, for approximately 48 hours. The resulting porous ceramic is then sintered to remove the binder and solidify the material structure. The size and type of pores can be controlled by the cooling rate, freezing temperature, and other experimental conditions. Freeze casting is a versatile technique that can be used to produce a range of highly porous structures, suitable for applications where a high surface area is required!

Ferroelectric materials are a sub-group of pyroelectric materials that exhibit spontaneous electric polarization. When heated above their Curie temperature, ferroelectric materials transition into a paraelectric phase and lose their spontaneous polarization. When cooled below their Curie temperature, they transition back into a ferroelectric phase and regain their spontaneous polarization. My research is focused on using the pyroelectric effect to catalyse reactions, such as splitting water for hydrogen production and the disinfection of water. By cyclically cooling and heating the pyroelectric materials, the surface charge increases and decreases which can catalyse reactions on the surface of the materials."

E L E A N O R R O A K E



SOLAR SPECTRUM

SOLAR SPECTRUM

Perovskite, a solar technology which absorbs a wide range of the solar spectrum, is now widely used on surfaces inc residential roofs, industrial buildings, and coated over poly-tunnels, turning urban areas into energy generating hubs. The flexible and durable bio-based polymer 'carrier' of the perovskite liquid means it can be applied to existing structures, minimising waste and the need for new roofs or buildings.

Black perovskite coatings are used on residential buildings, red is used on agricultural poly-tunnels, and yellow is used to power the production of sustainable energies such as hydrogen.

ENERGY + WATER // RENEWABLE
FEEDSTOCKS + BIO-TECHNOLOGY

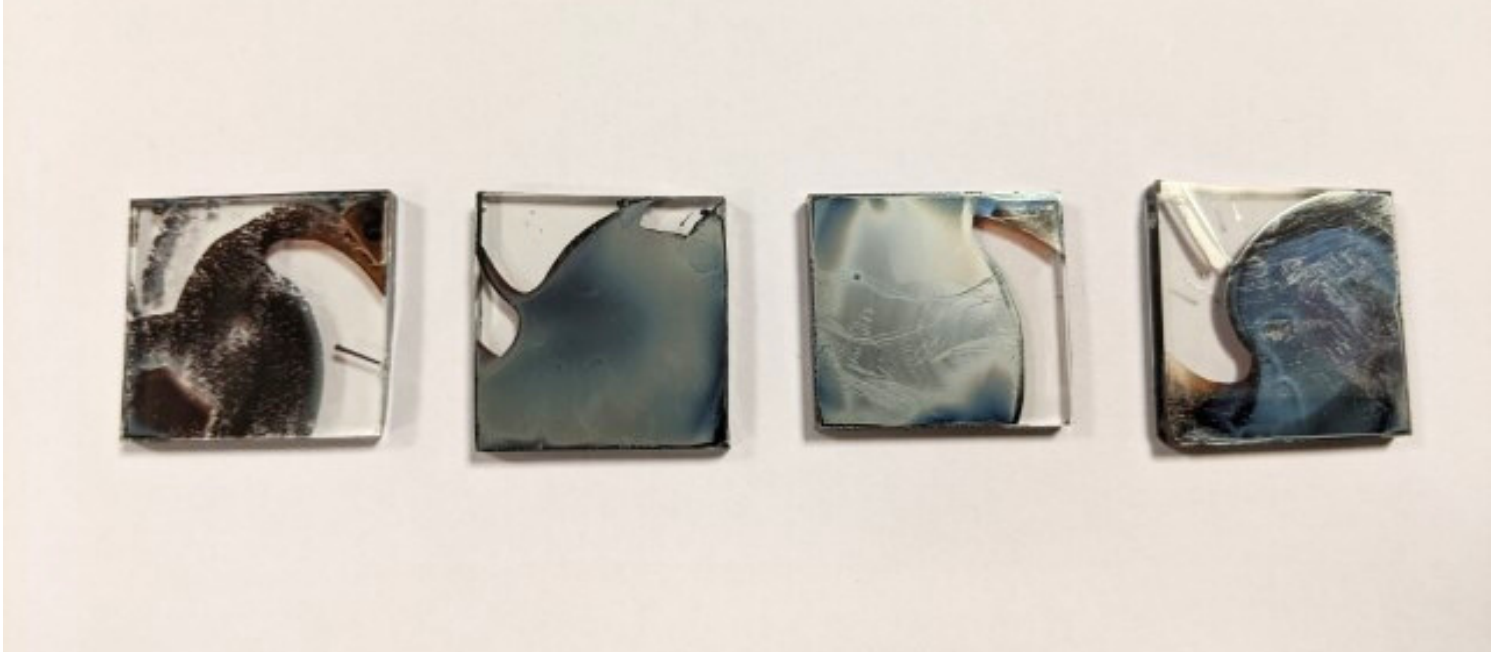
SOLAR SPECTRUM

RESEARCHER INFORMATION

"At the IFS we study lead halide perovskites from a theoretical perspective, predominantly focusing on the effects of mobile ions on the performance of solar cells. This class of material is of interest as it can enable a wide range of solar technologies in the future as the wavelengths of light absorbed can be tuned via the chemical composition chosen.

For solar panels with a single layer absorbing light, black lead halide perovskites with careful energy and crystal engineering have been optimised for maximum energy efficiency, whereas perovskite layers designed for use in tandem with conventional solar cells are often tuned to absorb a specific set of wavelengths not utilised by silicon. Lead halide perovskites may also see use in agricultural applications in future by their adoption for use in polytunnels, with red tinted perovskites being able to absorb portions of the solar spectrum that plants are unable to capture. The electricity generated can then be used for heating or water pumps. Clean fuels can benefit from yellow perovskites tailored to absorb only high energy photons that are then used to power the generation of hydrogen from water. Our work helps understand the complex interactions between the electrons generated by sunlight and the perovskite crystal structure itself, providing opportunities for characterization, improved stability, and increased performance."

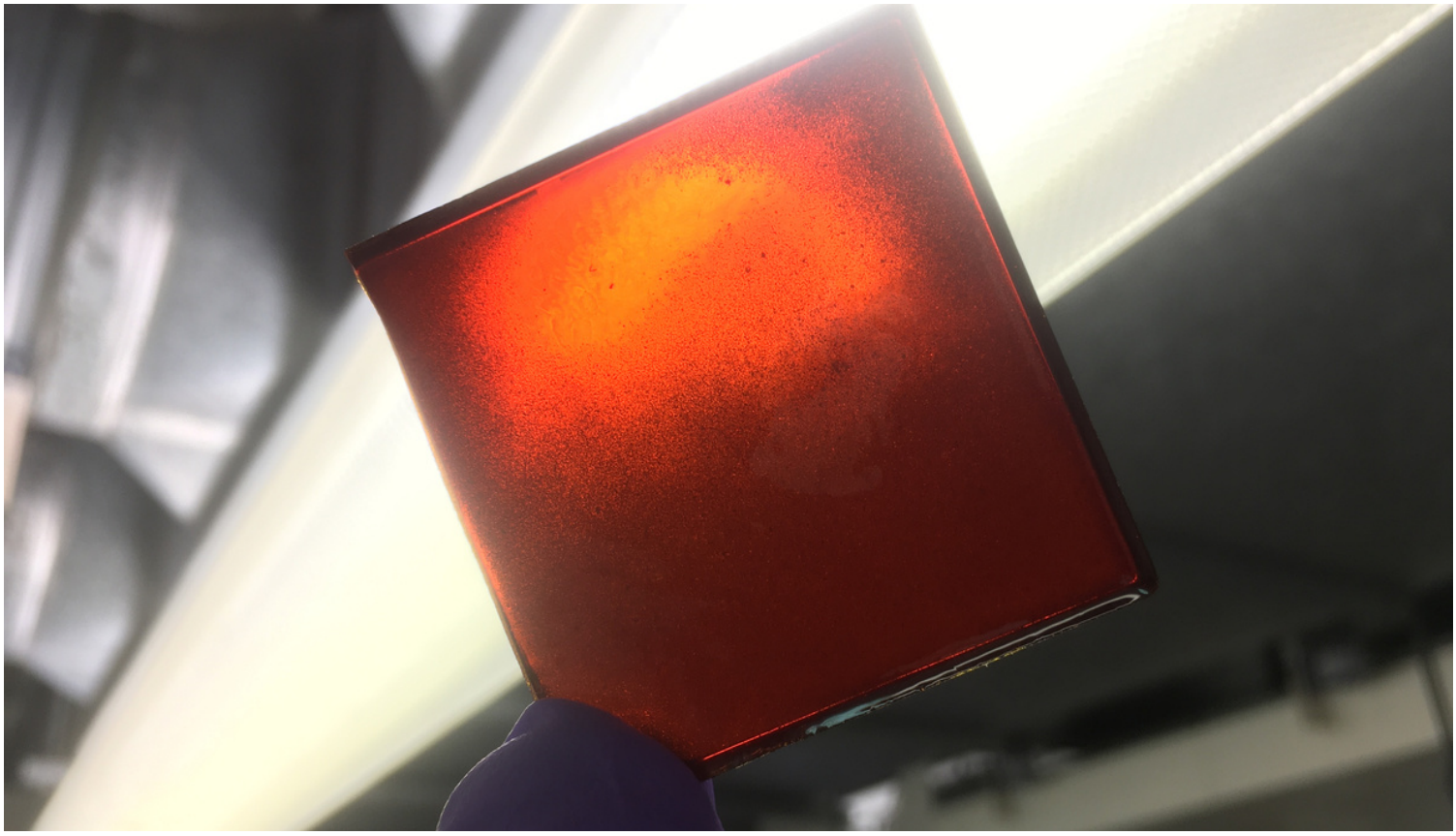
MATT COWLEY



"Bio-based polymers are a rapidly growing industry, having numerous benefits over petroleum derived plastics being bioderived, non toxic and often biodegradable. Polymers are long chains of small molecules called monomers; my research aims to use monomers derived from sugars. These sugars can be found in a whole range of plants, their chemical complexity making them challenging but interesting monomers. These properties have a huge impact on the final polymer and can be used to control the flexibility and strength of the final material."

Ella works with Xylose, mannose and epoxidized linseed oil to create the flexible polymers.

E L L A C L A R K E



CARBON CAPTURE

CARBON CAPTURE

Carbon, the chemical 'backbone' of life on earth, and, until very recently, an element that was being released into the atmosphere in vast quantities.

The widespread implementation of a combination of seasonal and sustainable energies such as solar, wind and hydro have seen carbon dioxide emissions greatly reduce.

In addition, carbon dioxide from the atmosphere is now commonly captured and solidified - the solid carbon, in various forms, is being used in a wide range of applications, including in the production of sustainable energies such as green hydrogen. A win-win scenario.

ENERGY + WATER // PROCESSES + MANUFACTURING

CARBON CAPTURE

RESEARCHER INFORMATION

"Solid carbon (solidified from carbon dioxide) is produced in the form of flakes and they are electrically conductive... given their electrical conductivity, could be excellent as 'electrocatalysts' for water splitting to make green hydrogen.

Carbon molecular sieves can be used to separate oxygen and nitrogen in air without using much energy. They have a very large pore network inside (in a similar way to our lungs having an internal surface area similar to a tennis court), when exposed to at least two chemical molecules, which can be gas or liquid, they can retain one in preference over the other. This can be based on molecule size or by its interactions with the carbon pore surface.

Carbon in the form of graphite is used to produce hydrogen from water by alkaline electrolysis.

Platinum supported on carbon is also crucial for the electrode of a PEM electrolyser which also produces hydrogen from water. These are the two dominant technologies by which we can make hydrogen from water - green hydrogen - assuming renewable electricity is used."

DOCTOR ALF HILL

NETTLE NET

NETTLE NET

Since the widespread ban of using plastics in our oceans, the fishing industry has returned to using methods seen in the pre-industrial era.

Traditional fishing net-making has seen a resurgence, using natural cultivated fibres such as flax or hemp, and even utilising plants that grow in abundance in the wild such as nettle, chosen for their relative strength.

These nets are often coated in a DIY bio-plastic to improve their durability and longevity. However, these are natural fibres with their own material limitations - large nets become too weak making trawling is impossible.

The limitations on scale, in addition to great reductions in plastic pollution has allowed fish stocks to replenish, and local communities are seeing the economic benefit of more localised trade.

NETTLE NET

RESEARCHER INFORMATION

So called 'bioplastics' are often considered to be the solutions to plastic pollution on land and in the ocean. Advertisers use the terms 'plant based' and 'biodegradable' to give the consumer the impression that these plastics will degrade easily but in fact this is not true. Specific conditions are required for rapid degradation of most of these plastics and conditions in the natural environment are far from optimal. Biodegradable fishing nets, for example, sound great! Fishing nets easily get into the environment and if they biodegraded and disappeared pollution would surely be reduced. Unfortunately, our research and the literature suggest that these plastics could take years to start degrading in marine conditions thus not solving the accumulation problem. During degradation it is likely the these 'bio-materials' could release microplastics as well as additives into the environment. These particles have been shown to reduce feeding capacity and reproductive capacity of zooplankton. These creatures are an extremely important part of the food chain and a negative impact on them could affect the whole ecosystem.

In short, bioplastics are not a silver bullet for the problem of plastic pollution. While scientists must consider the end-of-life options for plastic waste, we must also plan to get long-term use out of these materials to make them truly sustainable. Reduction in plastic pollution requires bigger solutions such as changes in behaviour on all levels from industry to government to consumers.

FANNIE BURGEVIN //
ELEANOR TRUDINGER CHARNLEY

KIT HOUSE

KIT HOUSE

New buildings are now created from a 'patchwork' of sustainable, natural materials and waste materials. Ancient building methods such as thatch and cob are seeing a resurgence, in tandem with hi-tech engineering solutions which create strong and efficient structures. Architects, developers and self builders are now accustomed to choosing from a selection of materials that change from area to area, season to season. In the Bath area, June 2073, the following materials are available to build a two bedroom detached home:

- Earth
- Rubble
- Clay
- Straw
- Oak timber (limited supply)
- Mycelium insulation
- Corrugated carbon-composite
- Hemp PLA composite
- Recycled glass double glazing

At the end of a buildings life, it is carefully deconstructed - salvageable elements are reclaimed for use in another building, and the rest is left to decompose back into the earth, nourishing the land.

SYSTEMS // RENEWABLE FEEDSTOCKS + BIO-TECHNOLOGY

KIT HOUSE

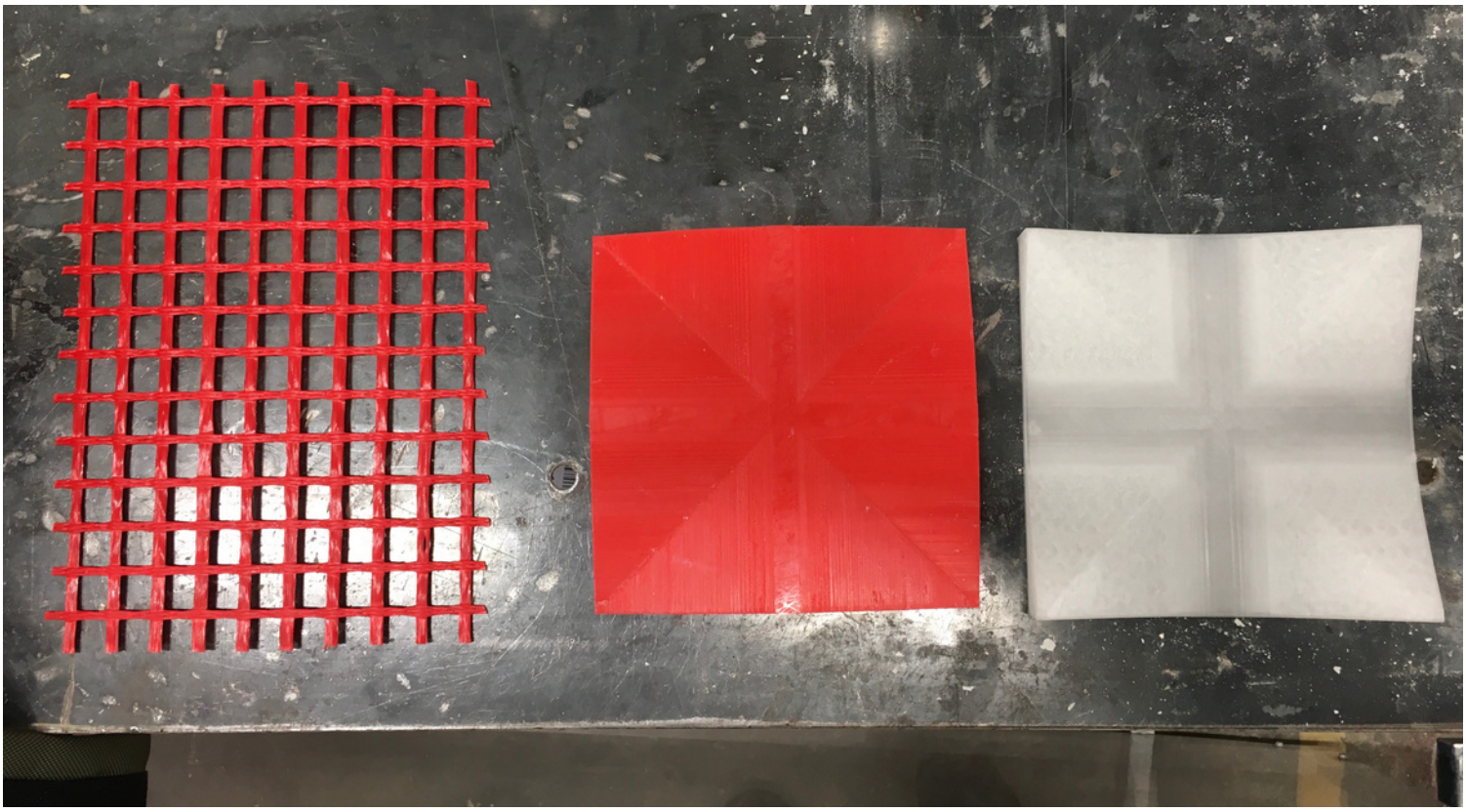
RESEARCHER INFORMATION

"In a future of zero-carbon construction, we will use advanced design, analysis and fabrication methods to both minimise our consumption of new materials (extracted from the biosphere), and maximise the re-use potential of old materials (recovered from the Technosphere).

New structural components can be made with minimal material through optimisation of their form, using various mathematical and computational techniques. These typically reveal that using curved, organic forms is significantly more efficient than today's typical straight-sided components, echoing nature's solutions for shells, bones and trees.

Reusing existing, or waste, materials for construction should be a sustainability priority, but with a much restricted library of components to use, this 'inventory-constrained' design approach is the inverse of the default 'bespoke' mindset of today. However, new design methods are emerging which allow designers to allocate available components to new structures in optimal ways, supporting the transition to a more circular construction industry."

DOCTOR WILL HAWKINS



"A growing body of evidence has shown the potential for emissions reductions through re-materialisation of the construction sector with efforts focusing on buildings as a carbon sink, and fast-growing bio-based materials. Among these various supply-side measures, society is putting its hope on mass timber solutions and high-tech bio-based products that are either particularly dependent on extraction beyond the natural resource boundaries of the Biosphere, or that will be difficult to implement at scale within a short time scale (i.e by 2050).

In contrast, whilst materials from the Biosphere are depleting, two thirds of waste produced in the UK comes from demolition and excavation, creating a material stock from the Technosphere. My project aims to determine the material palette compatible with a zero emissions future, using today's technologies. This will likely be made up of materials rooted in specific cultural and natural landscapes and include: naturally low-energy materials such as stone, fast-growing crops, mycelium, earth and timber; components re-used and repurposed from demolition; and electrified supplies of recycled steel, cement and bricks, albeit limited by a constrained supply of non-emitting electricity under high demand."

CHARLOTTE TAYLOR

BODY LANGUAGE

BODY LANGUAGE

Electrical and chemical bio-sensor technologies have been used for over 40 years as a preventative diagnostic tool within the healthcare industry, relieving stress on the NHS and providing cheap and accessible healthcare to many thousands of people.

In more recent years, these monitoring technologies have become more advanced - partnering with VR technologies to translate data into highly visual content for our personal devices. These technologies have become seamlessly integrated into our everyday lives - monitoring our personal health markers for a wide range of wellbeing purposes.

The connection between our exterior and interior worlds has never been so visceral, and thus, the term "body language" has taken on a new meaning - now short hand for knowing intimately, the internal function, health and personal language of your body.

HEALTHCARE TECHNOLOGIES

BODY LANGUAGE

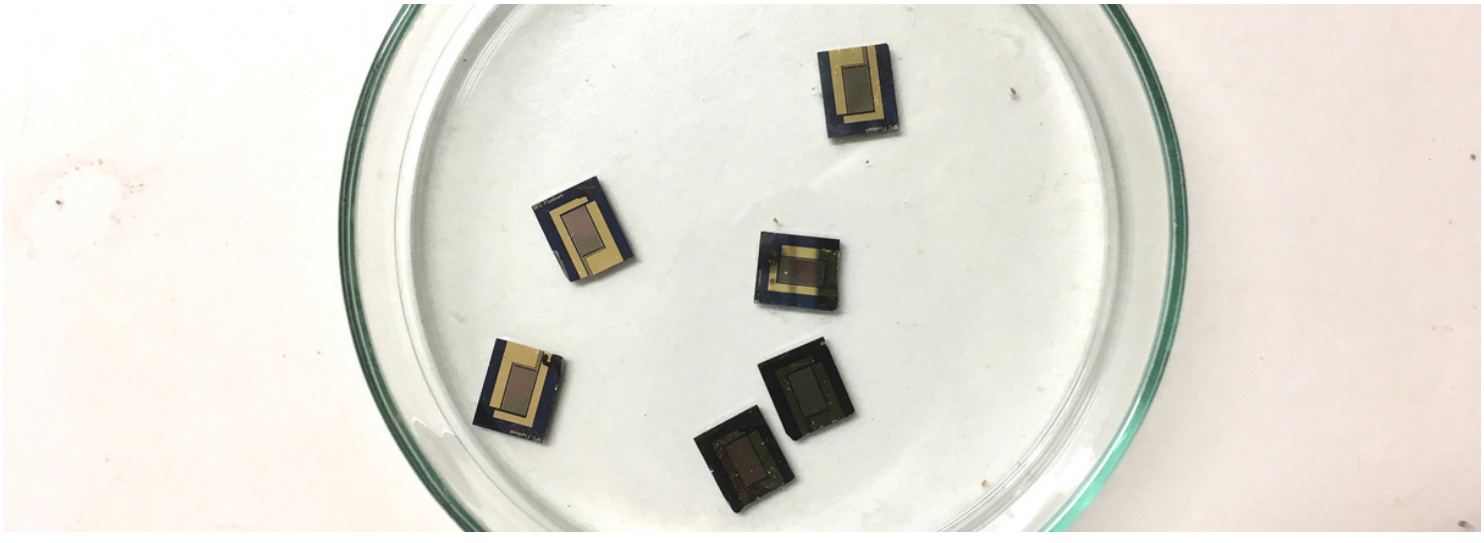
RESEARCHER INFORMATION

Pedro is developing low cost, accessible and personalised healthcare solutions. Using electrical and chemical bio-sensor technologies to create lab on chip and organ on chip devices, these technologies are able to accurately diagnose health conditions and help to reduce the severity of future pandemics. "The reliability of data is extremely important if diagnostic decisions are going to made based on the information". He is passionate about "democratising healthcare" and providing "diagnostic technologies in low resource settings - developing low cost technologies that are easy to use in, for example, sub-saharan countries."

In 5 years time he sees "lab on chip technologies being used everywhere in the health care system - GPs will send tests to people to use at home in their own time, for whatever condition they might be testing for. The technologies are ready to go, but investment and willingness from the health care is needed for it to take off. These technologies could be used to help the NHS in its current condition, cut down on doctor-patient time, reduce costs etc."

In 50 years "technologies are much more seamless and integrated - continuous monitoring of different things through patches or micro-needles - the tissue just under the skin (that holds a lot of information), heart rate, oxygen levels, fitness… everything is integrated. There are lots of options on the market already that monitor things happening outside the body, it is much harder to monitor what happens w the body" which Pedro's research is developing.

PROFESSOR PEDRO ESTRELLA



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