Annual Joy Welch Post-Doctoral Grants Fund (2021)

In October 2021, with the generous support of the Joy Welch Educational Charitable Trust, Lancaster University was pleased to run the first round of the annual Joy Welch Post-Doctoral Grants Fund.

This funding scheme was open to all Lancaster University researchers, with the aim of supporting research projects across all areas of research and all disciplines.

Under the provision of the agreement between the Joy Welch Educational Charitable Trust and Lancaster University, a total amount of £80,000 was available in 2021 to award to a minimum of 12 research grants.

In order to apply, Lancaster University researchers were required to complete a research proposal no longer than 1,000 words, alongside a short application form.

31 eligible applications were received under the terms of the scheme.

A review panel of four research-active academics, representing each of Lancaster University's Faculties, was convened to consider all of the eligible applications. Panel members voted for their preferred projects.

The panel comprised of:

Professor Nick Race, Associate Dean for Research, Faculty of Science and Technology *(Chair)*
Professor William Pettigrew, Chair in History, Faculty of Arts and Social Sciences
Professor Jennifer Logue, Associate Dean for Research, Faculty of Health and Medicine
Professor Katy Mason, Associate Dean for Research, Management School

Following panel consideration and individual ranking, there were sufficient funds available to make 12 awards, totalling £76,756. These awards were made to researchers at various career stages and across a variety of disciplines.

Panel Chair, Professor Race, commented, "As a panel we would like to thank the Trust for their generosity in establishing an endowed fund to support Lancaster University researchers in perpetuity. Panel members were extremely impressed by the quality of the applications received and are delighted that 12 awards will be made to Lancaster researchers. Through these awards, we very much look forward to seeing the fruits of the trustees' generosity in the years ahead."

Awarded Projects

Abby Haworth

Chemistry   *Amount Requested*   £6,850.00   *Awarded*   £6,850.00

Development of New Signal Enhancement Methods for Studying Protective Battery Electrode Coatings

The aim of this project is to develop a new method for studying the atomic structure of alumina coatings on lithium-ion battery electrode materials. These coatings have the potential to increase battery lifetimes, however, the coating's structure and interface need to be better understood before they can be optimised.

Alejandra Zarate-Potes

Biomedical Life Sciences   *Amount Requested*   £7,000.00   *Awarded*   £7,000.00

Resolving the dual extraction bottleneck in transciptomics for a deep understanding of host microbe interactions

Human healthy ageing and the onset and severity of age-associated diseases strongly depend on interactions with our commensal gut microbes (microbiota) and lifelong encounters with microbial pathogens. The evolution of antimicrobial resistance in disease-causing microbes poses a further associated challenge. Tackling such issues requires a deep mechanistic understanding of host-microbe interactions, which currently eludes us partly due to technical limitations. One of them is the difficulty to simultaneously measure changes in gene expression in both host and microbes, which could tell us what host genetic pathway 'talk to' what microbial genetic pathways. If we crack this, we could 'trick' microbes into working for us instead of against us. A key methodology to investigate the molecular basis of host-microbe/bacterium interactions is RNA sequencing (RNAseq), a next-generation sequencing technique that measures gene expression levels for the whole genome. Due to mechanical and biochemical differences between bacteria and animal tissues, and because host transcripts often greatly outnumber microbial transcripts, co-extracting and sequencing coding RNAs from an animal host and its microbes (dual-RNAseq) is particularly challenging. This project will tackle this bottleneck, unlocking dual RNAseq for the study of host-microbe interactions in the model nematode C. elegans and possibly beyond. I will optimise the co-purification of coding RNAs from C. elegans and associated microbes to enable truly genome-wide dual-RNAseq, which will be applied to clinically relevant host-microbe pairs to inform future studies.

David Clancy & Muhammed Munir

Biomedical Life Sciences   *Amount Requested*   £6,960.00   *Awarded*   £6,960.00

Drosovir – Discovering small-molecule SARS-CoV-2 antivirals from Drosophila eggs

When insect larvae emerge from eggs, they are very vulnerable to infection. We predicted that females would supply molecules on the surface of eggs which provide immediate protection to young larvae. We have demonstrated antibiotic activity by washing eggs of the Drosophila fruit fly and doing successive fractionations. We then used this technique to look for antiviral activity against SARS-CoV-2, which causes COVID-19. One fraction provided very strong protection to human respiratory cells against coronavirus. In this project, we will further characterize these molecules which could prevent or treat coronavirus infection, and propose novel natural compounds as treatment against viruses of public health importance.

Susannah Coote & Morgan Gadd

Chemistry & Biomedical Life Sciences   *Amount Requested*   £6,000.00   *Awarded*   £6,000.00

Showcasing Prismanes as Privileged Architectures in Medicinal Chemistry

This project will allow the production of novel, bespoke molecules (prismanes) as well as evaluation of their potential in medicinal chemistry. Prismanes are particularly attractive due to their three-dimensional shape (the core is made up of six carbon atoms arranged in a triangular prism), which are expected to interact better with biological targets (since these are also three-dimensional) than the flat molecules that have traditionally been pursued in medicinal chemistry and drug discovery. However, prismanes are difficult to make, and this project focuses on developing a creative new approach based on work recently carried within the PI's group.

Rupert Griffiths

Lancaster Institute for Contemporary Arts   *Amount Requested*   £5,632.00   *Awarded*   £5,632.00

Sensing the luminous night: Innovations in capturing and communicating observations of light pollution in an area of natural beauty

The Arnside and Silverdale designated area of outstanding natural beauty (AONB) in Cumbria is currently grappling with efforts to document artificial light at night (ALAN), raise public awareness, and potentially change lighting behaviours in the area. ALAN is typically monitored through late night sky-quality meter readings and photographic surveys, requiring time, specialist skills, and equipment. Making such information accessible and engaging is also a challenging and specialist activity.

To address these challenges, this project will develop new methods and methodologies that approach data collection, dissemination, and interpretation as a hybrid fieldwork practice and cultural activity. Working at the nexus of art, design, technology, and the geohumanities—particularly cultural geography, environmental humanities, and geopoetics—it will it will develop innovative methods, practices, and artifacts for sensing the night and communicating observations. In particular, these will make legible the temporal rhythms and syncopations of both natural and artificial light across diurnal, circalunar, and annual time scales. The project is framed by a broader aim to create temporal descriptions of the environment that can powerfully engage individuals and societies with the effects of anthropogenic activity.

Rob Young

Physics   *Amount Requested*   £6,300.00   *Awarded*   £6,300.00

Scalable 2D material fabrication for product security

Current security devices for authenticating products are flawed as they can be cloned with present day technologies. Holograms, for example, are widely used as seals of authenticity despite being easily counterfeited. Tags comprised of quantum materials offer a game-changing alternative; allowing atom-scale fingerprints to be read with a standard smartphone. This empowers everyday consumers, users, and anyone in the supply chain to identify individual tags, which are practically impossible for an adversary to copy due to the nanoscale properties of the material. In previous work, we successfully developed anti-counterfeiting tags based on quantum dots (Q-IDs), but prototypes based on food-safe materials relied on fabrication processes that are prohibitively expensive for mass-market applications. In this project we will develop the processes necessary to produce 2D materials to make Q-ID tags in a fashion that is commercially scalable, which will allow them to be used on edible items – such as to directly label pharmaceutical products.

David Middleton, Neil Dawson & Sophie Lau

Chemistry & Biomedical Life Sciences   *Amount Requested*   £7,000.00   *Awarded*   £7,000.00

Repurposing asthma drugs for Alzheimer's disease treatment

This project builds on our exciting recent results and will search for a new therapy to combat Alzheimer's disease (AD), for which there is currently no cure. AD is the most common type of dementia in the UK, which causes a range of symptoms from mild memory loss in the early stages to severe cognitive impairment as the disease progresses. The disease involves the abnormal build-up of toxic forms of proteins that form sticky plaques and tangles in the brain, eventually leading to the destruction of brain cells. We have previously shown that the widely-used asthma-treating drug salbutamol can reduce the rate of AD plaque and tangle formation under controlled "test-tube" conditions. In this project we aim to test salbutamol in mice that have been genetically altered to develop AD symptoms. If we successfully demonstrate that salbutamol slows down the development of AD in these mice, then we have a strong case to fast-track the drug for testing in human patients, potentially having a game-changing impact on a disease that afflicts 44 million people worldwide.

Peter Hodgson

Physics   *Amount Requested*   £4,130.00   *Awarded*   £4,130.00

X-Ray Scattering Analysis of ULTRARAM memories

In my project I will be using X-ray scattering techniques to characterise the properties of ULTRARAM™ memories that are currently under development in the Physics Department at Lancaster University. A method will be developed to quickly and non-destructively measure the layers of the memory samples with atomic-scale resolution using X-rays. Accurate characterisation of the layers within the memory is vital, as a variation in thickness of just a single atomic layer can drastically alter their performance. The project will not only enhance the work on ULTRARAM™, but also the broader field of semiconductor research.

Alexander Robson

Chemistry   *Amount Requested*   £7,000.00   *Awarded*   £7,000.00

Exploration of early stage plasma polymerisation growth via ion-milling

This project aims to investigate the role that substrate material plays in the growth of thin-film plasma polymer (PP) coatings. PP is a quick (single step), self-contained, energy-efficient coating process that minimises waste and importantly can be applied to complex geometries, allowing functionality to be imparted to a material or product. However, while commonly used on an industrial scale, a lack of understanding of the pathways of PP has inhibited its full potential. PP films are regularly used in thickness ranges of up to microns, resulting in substantial use of raw material and energy, whereas control of surface functionality could enable much thinner films to be just as, if not more, effective. To optimise coating functionality, we require a fundamental understanding of the PP process, and to exploit recent results which show that there is a strong surface and plasma dependence in early stage growth.

We will use X-ray photoelectron spectroscopy and atomic force microscopy to investigate not only the initial stages of plasma growth, but to use advances in ion-beam milling technology to characterise films in depth, investigating the length scales substrate-based effects propagate through to in the film (i.e. over what film thickness the effect of the underlying substrate is observed), with the view to optimising functional coating processes for the development of more environmentally- and economically- friendly coating technologies. Modifications will be made to a PP reactor to allow enhanced control and reproducibility over the early stages of film growth, which will subsequently be explored and compared to conventionally deposited material. PP films will be grown using TEMPO (2,2,6,6-Tetramethyl-1-piperidinyl)oxy), with applications for controlling biofilms which affect sectors from healthcare through to food processing and marine applications.

Benjamin Robinson

Physics *Amount Requested* £6,900.00 *Awarded* £6,900.00

Solar-Thermal electricity energy generation an interdisciplinary study

To achieve the UK government's commitment to meet the Paris Agreement global temperature rise target and to Net Zero greenhouse gas emissions by 2050, we need new, effective methods of generating green electricity that are aligned with a circular economy approach that avoids waste through the superior design of materials, products, systems and business models, for example via use of renewable energy and the elimination of toxic chemicals.

Here we address this challenge by investigating a new class of energy generation devices, solar–thermal–electric generators (STEGs) using organic films assembled on tailored metamaterial substrates. Unlike the more well-known photovoltaic systems, STEGs store solar energy as heat in thermal storage materials; therefore, these systems do not need the installation of electrical batteries, which not only simplifies the structure of the system but also significantly reduces the associated cost and enabling applications ranging from remote off-grid power generation to waste heat harvesting with unprecedented efficiencies.

Kate Slade and Helen Nuttall

Psychology *Amount Requested* £7,520.20 *Awarded* £7,000.00

Hearing Health Inequalities: Time to Listen?

Hearing loss is often regarded as an unavoidable part of ageing and its burden on our overall health can be underestimated: Age-related hearing loss is related to increases in depression, social isolation, and cognitive decline. Importantly, hearing loss in later life may be avoidable. In fact, around 29% of 70+ year olds are unaffected. It is possible that health inequalities, such as socioeconomic position and lifestyle variables, may impact on hearing health in later life. The proposed project aims to investigate health inequalities associated with hearing function in middle-aged adults, to identify individuals at risk of developing hearing problems, and provide evidence for future hearing-health interventions.

Sam Jarvis

Physics *Amount Requested* £5,984.00 *Awarded* £5,984.00

LabCore for XPS: Developing a collaborative tool for nanoscale spectroscopy

This project aims to collect pilot data to develop a laboratory use-case study for a prototype digital platform, LabCore, designed to transparently record and store research data and metadata. The project is in collaboration with an industrial SME partner, Nanolayers, and it will help upgrade x-ray spectroscopy facilities managed by my group in Physics. The compatibility we develop between LabCore and the spectrometer equipment will dramatically improve research collaboration, allowing our research partners to easily view the data produced in our laboratories.