



ARC CTET

TRAINING CENTRE FOR Cell & Tissue
Engineering Technologies

In this newsletter:

- 2023 Workshop
- Research Highlight:
Validating starPEG-
Heparin Hydrogels as a
Drug Testing Platform for
Breast Cancer
- Centre Training and ECR
Grants
- Industry Partner:
TissueGnostics

Director's Message

Welcome to our industry partners and other stakeholders as we approach the middle of our third year as CTET. There have been many highlights this year including our second Centre workshop which provided opportunities to engage, network, hear about some great science, receive some training, hear from some of our industry partners and have some social time together.

During the workshop we were able to re-visit how we would like to achieve success and impact. We hope to hold another session to flesh this out in more detail. One of the key parts of this will be enhancing our outreach into industry, government and the general public.



Prof. Laurence Meagher
CTET Director

We also started a scheme where the postdoctoral fellows in the Centre could come together to apply for funding to establish new collaborations and enhance the outcomes from their work. We are looking forward to seeing the outcomes from this opportunity.

We have had a strong focus on training throughout the last six months or so, covering topics such as grant writing, social media training and networking and are starting to plan placements for the HDR students in the Centre.

The leadership team and I have been working with new partner organisations and prospective partner organisations to scope and deliver projects which meet their goals and provide the students, postdoctoral fellows and CIs the opportunity to work closely with industry on projects with impact. Please read on for more information on all these topics and also some highlights from our research.

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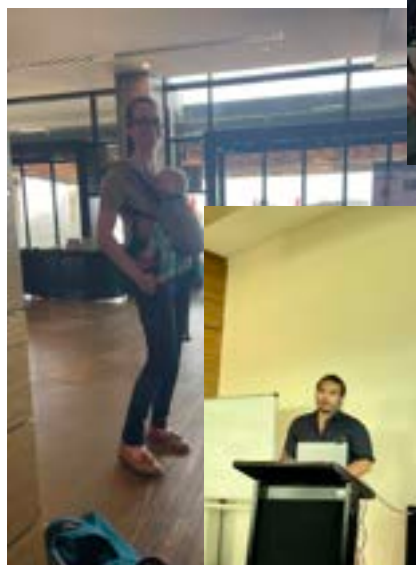
CTET Workshop 2023

In February, the week prior to university classes starting, we held the 2023 CTET Workshop. This year's program was held at The Sands, Torquay, where some members took full advantage of the golfing facilities on site. We experienced a full program, with talks from industry partners, a member of the Scientific Advisory Committee, students, postdocs and CIs. All students and postdocs either presented a 10 minute talk on their work, or a 3-minute teaser, so they could be introduced to all members of the Centre. Students and postdocs also undertook training on grant writing, in order to help them prepare to apply for the CTET ECR grant to help further their careers.

This year, we opened the workshop up to families and children, providing onsite childcare or covering costs for partners to watch children. This allowed for our Deputy-Director, who was officially on



maternity leave, to attend, and created a great atmosphere, promoting inclusiveness. CIs Uwe Dulleck and Rebekah Russell-Bennett ran a session on strategic planning, providing a number of areas to target, including education program options, social media, newsletters and online reporting. The next workshop will be held in Brisbane in February 2024. We would like to extend an invitation to all industry partners to attend.



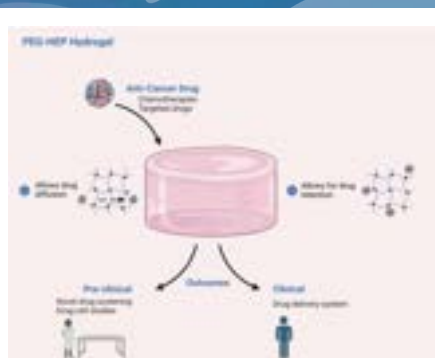
RESEARCH HIGHLIGHT:

Validating starPEG-Heparin Hydrogels as a Drug Testing Platform for Breast Cancer



QUT PhD student, Julien Clegg, has been working on this project, with Partner Organisation, Leibniz. He will be submitting his thesis in 2023.

Breast cancer is one of the most common forms of cancer affecting women, with an estimated 2.1 million new cases diagnosed each year worldwide. Despite advances in treatment and early detection, breast cancer remains a leading cause of death among women. To date, 2-dimensional (2D) models have provided a tremendous understanding of the biology of cancer and for novel drug development, however the continued death rate indicates a need for better understanding of the underlying biology and the development of more effective therapeutic strategies, potentially with emerging 3D technologies. In this project, we have been characterising hydrogels in order to create a drug-screening platform.



Hydrogels are 3-dimensional semi-solid structure with high degree of water, in this case composed of poly(ethylene glycol) (PEG) and heparin (Hep). Poly(ethylene glycol) and heparin are both biocompatible and biodegradable materials, and these PEG-Hep hydrogels have a structure that mimics the extracellular matrix of living tissues. These hydrogels can be used to culture breast cancer cells in vitro, providing a platform to study the behaviour of these cells in a more physiologically relevant environment. As such, we have been investigating how current anti-cancer drugs interact and are retained in our hydrogel system.

In our research thus far, we have discovered that different drug compounds interact differently with our hydrogel system than in the traditional 2D systems. The 3D systems have revealed that these anti-cancer drugs have difficulty penetrating the tissue environment, therefore limiting the effectiveness shown in 2D systems, and their

potential clinical effectiveness. These findings inform future in vitro drug studies, but also provide foundational work for more sophisticated drug-diffusion studies that will inform appropriate drug testing in the hydrogel system, and shows promise for future applications for drug delivery using PEG-Hep gels.

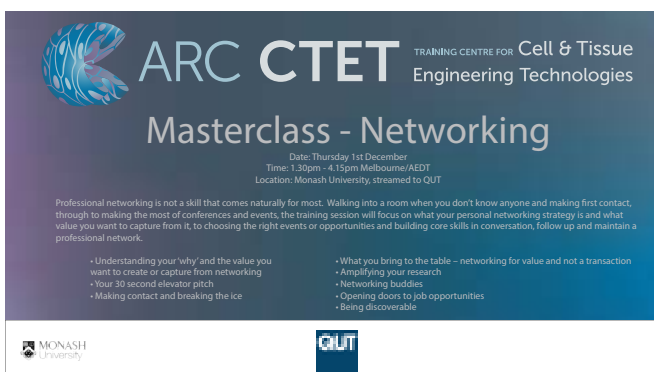


Furthermore, we have been rigorously testing many breast cancer cell lines in our system against a multitude of different anti-cancer drugs. We have found that our system has a trend to support the survival of breast cancer cells (BCa) when treated with anti-cancer drugs in 3D compared to their more sensitive responses observed in 2-dimensional systems. Additionally, we have investigated spheroid formation capabilities of BCa cells in our system and their ability to remodel their local microenvironment and migrate to one another. We have demonstrated that our PEG-Hep gel supports many cancer hallmarks and shows it to be a mammary biomimetic, indicating its usefulness to screen drugs for anti-cancer therapies and better understand the mechanisms of breast cancer cells.

We hope to further push the boundaries of our system by incorporating patient-derived breast cancer cells and characterising their responses in our 3D model.

CTET Training

As part of the CTET Education & Training Program, a number of masterclasses have been offered to students and postdocs. In October 2022, students and postdocs from QUT visited Monash to complete a number of masterclasses. Additional masterclasses were run via zoom in November and December.



ECR Grant Recipients

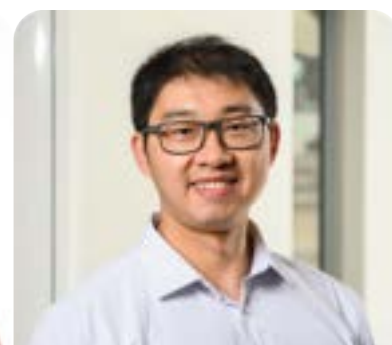
In 2023, CTET offered \$10k grants to ECRs to help Centre postdocs do additional projects in order to build their collaborative network and further their careers. Dr Sacha Cavelier (QUT), Dr Crystal Chen (Monash) and Dr Edward Ren (QUT) were the successful recipients of these grants, putting together excellent applications, and building links within CTET across different projects and universities.



Dr Sacha Cavelier



Dr Crystal Chen



Dr Edward Ren

At the 2023 CTET Workshop, students and postdocs undertook training in grant writing, in order to prepare to submit the applications for the ECR grants.

In addition, CTET members were asked which areas they thought training should be provided, and they responded with the following ideas. The Education Committee is currently taking these responses under advisement for future planning.



CTET Industry Partner:

TissueGnostics came onboard with CTET late in 2022. TissueGnostics will be partnering with QUT, and will soon begin a project with a PhD student relating to tissue cytometry.

TissueGnostics (TG) provides fully integrated cutting-edge tissue cytometers capable of whole-slide imaging and high-end image analysis. The goal is to bring the same type of phenotypical and functional analysis as known from flow cytometry (FACS) into tissue context, and on the level of single cells.



TISSUEGNOSTICS
PRECISION THAT INSPIRES



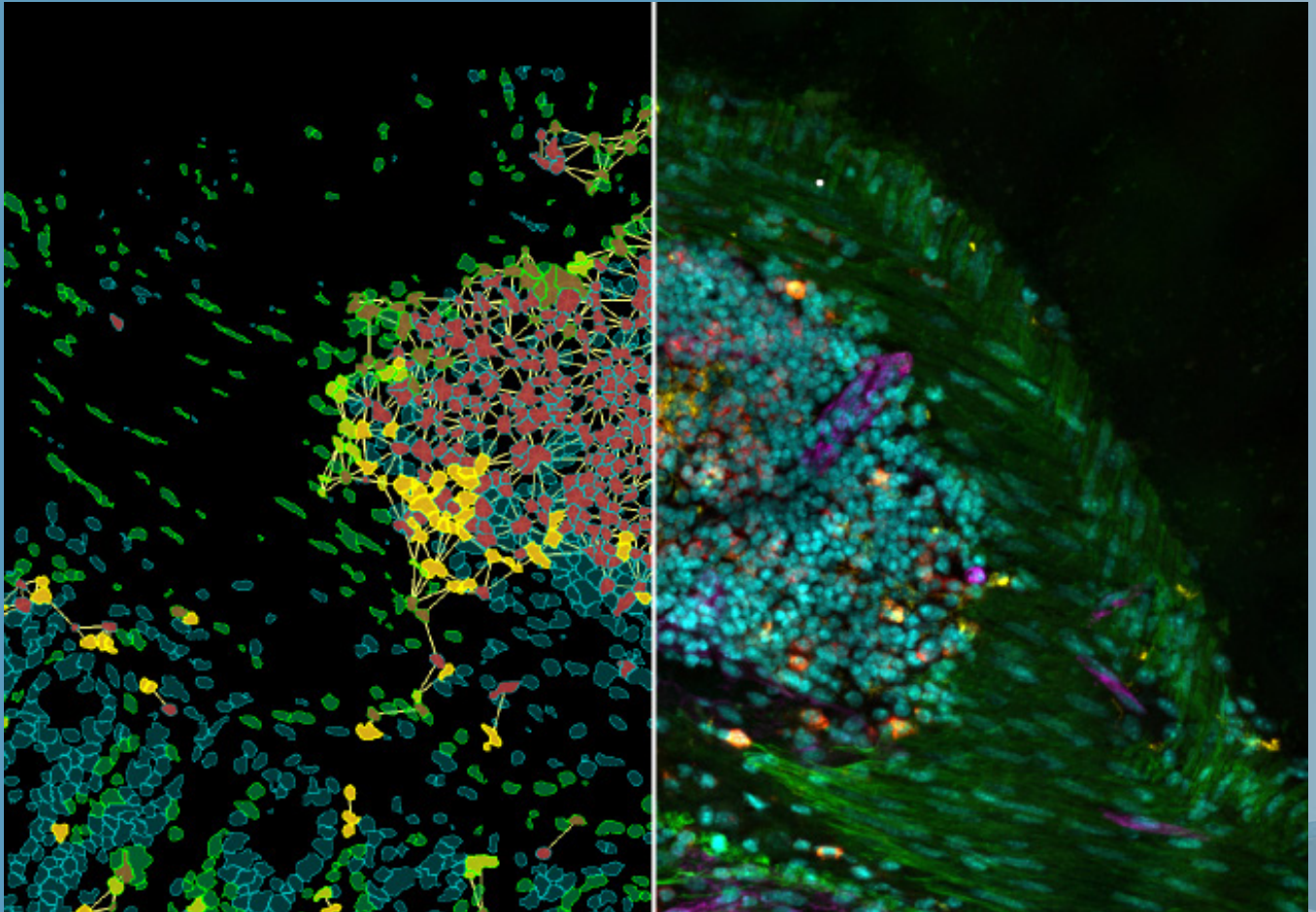
CTET PI: Dr Rupert Ecker

TG's tissue cytometers are highly flexible and modular and are available in multiple configurations for whole-slide imaging (WSI) in brightfield, fluorescence, multispectral, confocal mode for automated scanning of either 8 slides or 120 slides for high-throughput imaging. TissueGnostics high-end image analysis solutions allow for :

- **Immunophenotyping** – identification of cellular phenotypes based on 1 – x markers
- **Spatial immunophenotyping** – characterization of cellular phenotypes in spatial context
 - Identification of single cells even in dense tissue (e.g. lymphatic organs) through deep learning algorithms
- In-depth analysis of **organoids, embryoid bodies and spheroids**
- **Automated classification of tissue** structures by machine learning or classical algorithms into any number of classes



TissueFAXS cytometers are highly flexible imaging and analysis platforms for IF/IHC processed samples



In-depth phenotyping and spatial analysis to assess immune cell interactions using the high-end image analysis solution StrataQuest (TissueGnostics)

- **Multiplexing and spectral unmixing** to perform high-plex assays
- Structural analysis of single cells and determination of subcellular marker localization
- **Molecular single-cell profiling** using FISH, CISH, RNA-ISH, RNAScope
- **Quantification of cellular pathogens**, including intracellular parasites (e.g. leishmania) and viral load (e.g. SARS-CoV-2, Influenza, HIV)

TissueGnostics has been founded in 2003 in Austria and is a globally active company with subsidiaries and offices in the EU, the USA, Asia-Pacific, South America as well

as South Africa. This year, 2023, TissueGnostics is celebrating its 20-year anniversary! We are happy to announce that TG's tissue cytometry solutions are being used for high-impact research worldwide. Our publication database comprises more than 2300 scientific publications, in more than 800 different peer-reviewed journals, from research groups in almost 70 countries on 6 different continents.

If you want to learn more about tissue cytometry visit: <https://tissuegnostics.com/>

Positions available:
PhD in Development of a Deep Learning-Based Quantitative
Multiplexing Staining Technology for Tissue Cytometry
QUT, TissueGnostics
Supervisors: Jyotsna Batra, Rupert Ecker