BioPRIA NEWSLETTER

July 2021

Internships spotlight - Thomas Stevenson & Clare Carew

We recently asked Thomas Stevenson and Clare Carew about their internship at BioPRIA.

Investigation on enzymatic flow reaction intensification by utilising a laser incubated micro-reactor

Spotlight on: Mr. Thomas Stevenson (Final year student—Chemical Engineering & Biomedical Science)

What was your project about and what are the outcomes?

My project involved researching the optimisation of a prototype reactor, which combines a microreactor with laser incubation. The first objective of the project was to validate reactor feasibility and to determine the maximum temperature achievable by altering several parameters. The next step of the project was to calibrate an online temperature control system using a well-documented enzymatic reaction. Following the integration of the control system with the microreactor, it is hoped the new reactor design will have the potential to produce high-value commodities both more cost effectively and efficiently than current industry standards.

Who were your mentors and how did having a mentor impact your working experience?

I was fortunate enough to have several mentors during my time at BioPRIA. My lead supervisor was Dr. Tanner, who conceived the project and was ever insightful when I came to her with challenges. Dr. Manderson provided a great deal of assistance when operating the high powered laser, as I had no previous experience in this area. The unit coordinator Dr. Batchelor also provided me with guidance with the non-research based outcomes of my project. Having mentors definitely improved my experience, as I was often working with new technologies I was initially unfamiliar with. I also found it advantageous when we bounce ideas off each other, as we all had different strengths due to our backgrounds, with my knowledge gaps often being filled with a quick question.

"What excited me most, was the chance to trail some of my interests and gain new experiences. I also learn better when I'm applying knowledge and this seemed like a great opportunity to put what I have learnt in my degree into practice."

What have you learnt and how will you apply these lessons moving forward?

I learned the importance of being flexible and embracing new challenges. When I applied for the program I didn't anticipate being placed at BioPRIA, but I'm grateful that it worked out that way. Completing a Biomedical Science degree as well as engineering, I had always considered pursuing a career in research. The project reminded me that although not all aspects of research are thrilling, having the ability to answer a challenging hypothesis is extremely fulfilling. Additionally, it was often quite easy to get overwhelmed when I was using new devices or materials I didn't entirely understand, so it was important to take a step back to review information and ask plenty of questions. I hope to apply these lessons in my future by taking on new opportunities even if I don't think I'm fully qualified to, as you broaden your knowledge base and feel more engaged in your work.

"I am grateful that I got the opportunity to complete this project, especially as it looked like this year's program may have been cancelled during the initial stages. I thoroughly enjoyed learning how to use cutting edge technology and will keep an eye on any updates, as I think the project has massive potential."

Optimising process for photocatalytic degradation of organic contaminants in water

Spotlight on: Ms. Clare Carew (Final year student - Chemical Engineering & Arts)

What was your project about and what are the outcomes?

My project has been to optimise a process for photocatalytic degradation of organic contaminates in water. This has involved working with Mostafa Dehghani to design a standalone process that utilises the power of sunlight, not only to enable photocatalytic degradation, but to also power UV lights that allow for the efficiency of the system to increase. The outcomes of my work have been to select UV lights that cover a specific bandgap of UVA light that has been selected for the ZnO catalyst. In times of the day where the UV levels are not strong enough to provide enough light for the photocatalytic reaction to run at maximum efficiency, the lights are able to turn on at an appropriate brightness to ensure that the reaction rate remains constant. Solar panels, which are able to harvest a broad spectrum of visible light, are used to power the UV LEDs, which increases the efficiency of the light capture and thus the reaction. Battery storage allows for the lights to continue the reaction overnight. I have also designed and programmed a control system using a raspberry pi microcontroller. This has been a very interesting and engaging process as I had to develop the logic of the system operations and then program them using python. I have also facilitated the integration of the other electrical components so that the prototype can be manufactured. I believe our work provides a gap in sustainable and low-cost water treatment methods for organic pollutants, especially in low resource settings. I hope that work on the prototype can continue to continue to optimise the design and process.

"Working at BioPRIA has allowed me to experience how research is conducted at universities and has opened my eyes to some of the current research being conducted in the chemical engineering field."

Who were your mentors and how did having a mentor impact your working experience?

I've predominately worked with Mostafa Dehghani throughout my time at BioPRIA with Warren Batchelor as my supervisor. It has been interesting to have Warren oversee my progress as he has been able to provide support and recommendations in our weekly meetings. Warren has been able to provide insight and ideas for me to explore and I am very appreciative of his guidance. Working with Mostafa has also been very enjoyable. He gave me a lot of responsibility to explore my own ideas on the project which has been a great learning opportunity for me. I have really enjoyed working in a team with both Mostafa and Mahdi to develop the direction of the prototype.

I have also been provided a lot of guidance from Mark Symonds from the mechanical engineering service desk. His assistance with the electrical components of the system has been invaluable. I have learned a lot about this discipline of engineering by working with him, and the project would not have been possible without his help.

What have you learned and how will you apply these lessons moving forward?

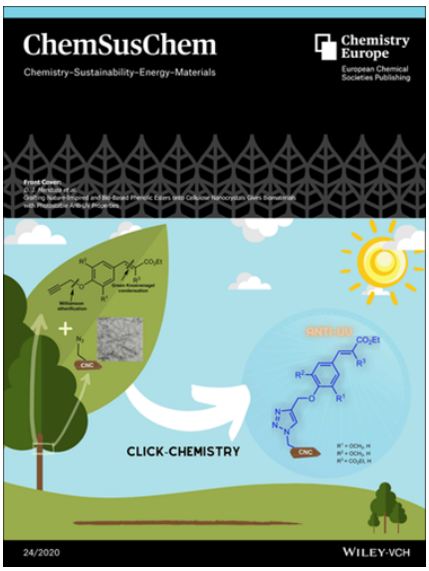
I have learned a lot in the process of designing and programming the control system. It has been really interesting to apply the process control principles of design in the context of real-world variables. Although this system is relatively simple, designing the logic from a programming angle has been really different to anything else I have done before. I came into the project with minimal experience in python and so I have really developed my skills in this area over the duration of the project.

The biggest learning for me on this project has been how important the intersection of chemical engineering and other engineering disciplines is, especially for an integration project like this one. As chemical engineers we are taught to think about design from a process lens, which looks at which outcomes we would like to achieve overall using different process variables. This is different to the more specific focus of other engineering disciplines. In this project however, the electronic and mechanical components of the system have been crucial in the design stage and getting them right has been very important. Quite a few hurdles arose in this project in areas that I never would have considered to be an issue previously. Additionally, the electrical components of the system which underpin the operation of the control objectives were a lot more complicated than I expected them to be. It was a learning curve for me to understand more about these areas of design and engineering and it has been a great opportunity to work with the mechanical engineering service desk to get specialist assistance. I have learned a lot about the importance of consulting with specialists in areas that are outside of my knowledge scope. I am hoping I can take this experience with me into industry, where I would like to work on large scale process management.

"This experience has been worthwhile. I have learned so much and I think the experience has made me a better engineer."

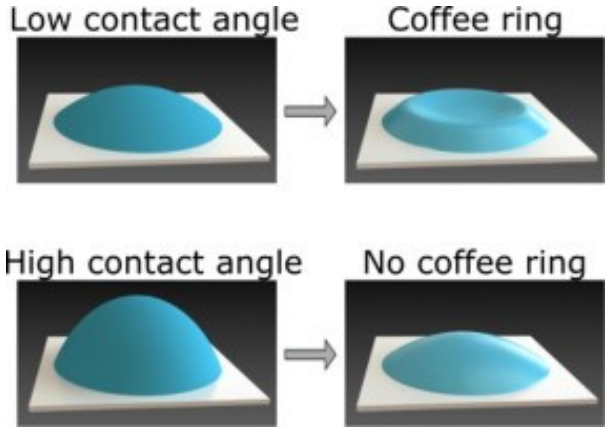
Research Spotlight

Grafting Nature-Inspired and Bio-Based Phenolic Esters onto Cellulose Nanocrystals Gives Biomaterials with Photostable Anti-UV Properties (ChemSusChem 24/2020)



Our international collaborative work with URD Agro-Biotechnologies Industrielles (ABI) - AgroParisTech was featured on the front cover of *ChemSusChem* journal. The work by Mendoza et al. shows how the grafting of nature-inspired and bio-based phenolic esters onto cellulose nanocrystals through click-chemistry, provides materials with photostable anti-UV properties. **Read more**.

Dr Michael Hertaeg et al. research on the mechanism behind the formation of "coffee rings" was covered by 2SER and Phys.Org.



In collaboration with Cambridge University, Dr Michael Hertaeg et al. developed a model that is capable of predicting when a coffee ring could be observed in hard spherical particle systems. The research identified the contact angle formed by the suspension on the surface and its solid content as the two important governing variables. Although successful modelling has been achieved previously, this study showed for the first time that for each contact angle, there is a critical initial colloid volume fraction over which no ring-like pattern will be formed. This modelling technique and its resulting insights are new powerful tools to optimise manufacturing and diagnostic techniques. **Read more**.

Award

Big congratulations to Dr Rodrigo Curvello who has won the 2020 Mollie Holman Award for this thesis entitle "Engineered nanocellulose hydrogels for biomedical applications", supervised by Professor Gil Garnier.

Rodrigo was also part of the Chemical Engineering COVID-19 task force team, where they developed a low-cost, rapid diagnostic test to detect antibodies against the coronavirus. He was interviewed by 4 TV channels in Brazil including major network Globo, reaching over 250 million people in South America.

The award was presented by the Dean of Engineering, Professor Elizabeth Croft on the 26th of May during the Faculty Celebration Event. **Media release**.

PhD Completions

Congratulations to Marek and Maisha whose PhD thesis have been approved! We wish them all the very best of success in their future endeavours.

- Dr Marek Bialkower. Thesis title: Engineering and Testing paper fibrinogen diagnostics. Supervisor: Prof. Gil Garnier
- Dr Maisha Maliha. Thesis title: Application of organobismuth-nanocellulose composites as antimicrobial materials. Supervisors: A/Prof. Warren Batchelor, Prof. Philip Andrews

Hello!

We are pleased to welcome two new PhD candidates, Craig Stocker and Hans Cainglet to the BioPRIA team. Craig will be working on the lignocellulosic fibres for sustainable agriculture, under supervision of Prof. Gil Garnier. While Hans's project will focus on processing recycled fibres into high value products, with Dr Joanne Tanner and A/Prof Warren Batchelor as his supervisors.

Conferences of Interest

28th July 2021—**Appita YPN Hybrid Conference**

27th-28th September 2021—**Chemeca 2021**