BioPRIA NEWSLETTER

July 2020

The past couple of months have been challenging for BioPRIA with the COVID-19 pandemic but we have also had some positives. The COVID-19 pandemic has been unprecedented but our teams have adapted accordingly by working from home and changing workplace practice and since June have been back doing their research in team A and B.

During the three months of total shutdown, BioPRIA along with the Department of Chemical set-up two task force for PPE and Diagnostics and worked tremendously to respond to this pandemic. The two teams conducted outstanding research work, in collaboration with Dr Simon Corrie and his teams to develop the COVID-19 antibody assay and initiated research activity to create a paper medical gown in response to the shortage of PPE for the health workforce. The BioPRIA teams have also worked hard to keep their research work progressing and have successfully delivered research outcomes, with ten high quality research publications published in the past few months. Two selected publications here, are showing the Hub work in nanocellulose gels.

At last, we want to thank all Monash/BioPRIA staff, research teams, students and our industry partners for their efforts and supports during this challenging time. Stay safe and well!

COVID-19 Research Highlights

World-first research by Monash University in Australia has been able to detect positive COVID-19 cases using blood samples in about 20 minutes, and identify whether someone has contracted the virus.

The research team, led by BioPRIA and Monash University's Chemical Engineering Department, including researchers from the *ARC Centre of Excellence in Convergent BioNano Science and Technology (CBNS),* developed a simple agglutination assay – an analysis to determine the presence and amount of a substance in blood – to detect the presence of antibodies raised in response to the SARS-CoV-2 infection.

Positive COVID-19 cases caused an agglutination or a clustering of red blood cells, which was easily identifiable to the naked eye. Researchers were able to retrieve positive or negative readings in about 20 minutes. While the current swab / PCR tests are used to identify people who are currently positive with COVID-19, the agglutination assay can determine whether someone had been recently infected once the infection is resolved – and could potentially be used to detect antibodies raised in response to vaccination to aid clinical trials.

Using a simple lab setup, this discovery could see medical practitioners across the world testing up to 200 blood samples an hour. At some hospitals with high-grade diagnostic machines, more than 700 blood samples could be tested hourly – about 16,800 each day. Study findings could help high-risk countries with population screening, case identification, contact tracing, confirming vaccine efficacy during clinical trials, and vaccine distribution.

This world-first research was published today (Friday 17 July 2020) in the prestigious journal *ACS Sensors*. A patent for the innovation has been filed and researchers are seeking commercial and government support to upscale production.

Dr Simon Corrie, Professor Gil Garnier and Professor Mark Banaszak Holl (BioPRIA and Chemical Engineering, Monash University), and Associate Professor Timothy Scott (BioPRIA, Chemical Engineering and Materials Science and Engineering, Monash University) led the study, with initial funding provided by the Chemical Engineering Department and the Monash Centre to Impact Anti-microbial Resistance.

Dr Corrie, Senior Lecturer in Chemical Engineering at Monash University and Chief Investigator in the CBNS, said the findings were exciting for governments and health care teams across the world in the race to stop the spread of COVID-19. He said this practice has the potential to become upscaled immediately for serological testing.

To download a copy of the research, please visit https://doi.org/10.1021/acssensors.0c01050 . To watch a video of this research in action, please visit https://www.youtube.com/watch?v=9WBQUC43u9Q&feature=youtu.be. This research has been featured in the 9News: https://www.9news.com.au/national/coronavirus-monash-university-rapid-blood-test-developed-in-melbourne/04684e48-b5cf-4fa3-a10f-d17fc0582662#close

COVID-19 Research Highlights

PPE Medical Gown from Laminated Paper: As the world is facing a lot of new challenges due to the COVID-19 pandemic, a major one being shortage of personal protective equipment or PPE. This leaves the people around the world, especially the ones on the frontline, under huge risk of infection. There was even news of people wearing garbage bags in the hospitals. This shortage of PPE has driven researchers in BioPRIA to look for a solution with paper as a new type of material for medical and isolation gowns. Professor Gil Garnier, director of BioPRIA, in close alliance with APPITA and a panel of industry experts started the initiative.

A dynamic team of paper manufacturer, functional coating manufacturer, pulp and paper researchers, biologists and material scientists came together to join in this initiative and formed the COVID-19 PPE task force team. This includes BioPRIA researcher, Dr. Joanne Tanner and Head of the department of Chemical Engineering, Professor Mark Banaszak Holl. Three PhD candidates in BioPRIA - Laila Hossain, Maisha Maliha and Ruth Barajas projected the team and performed the testing and characterisation.

Laminated papers were prepared and optimised by testing the barrier properties, mechanical strength and virus protection. By the end of the project, the team successfully optimised the best material capable of meeting the legislations and regulatory requirement according to the AAMI PB70 standard.

Distinguished Seminar: Surface science - applications and some principles

Prof Hans J. Griesser, Emeritus Professor, University of South Australia

Before the pandemic, BioPRIA hosted a Distinguished seminar on "Surface science" by Professor Hans Griesser from University of South Australia. The seminar attracted over 30 Hub members, students and staff of Monash Chemical Engineering.

At the seminar, Prof Griesser described how plasma polymerisation has been used in his labs to deposit ultrathin polymeric coatings of thicknesses in the range of a few nanometres to a few tens of nms. Such coatings can markedly affect the responses of biological systems in contact with materials, which is relevant to the design of biomedical devices. He gave a brief overview of surface analysis techniques that can probe the details of surface layers that determine interfacial interactions. He also discussed how interfacial interactions between materials and their environment can be studied in terms of interfacial forces, and how understanding and control of interfacial forces leads to rational design of coatings appropriate to specific applications.

About Prof Griesser

Prof Griesser obtained his PhD degree Dr. sc. nat. (Latin abbreviation for Doctorate in natural sciences), which is the standard denomination from the Swiss Federal Institute of Technology (Eidgenössische Technische Hochschule, ETH) Zürich, Switzerland. At UniSA Prof Griesser was Deputy Director of the Ian Wark Research Institute from 2002 until early 2013; and was Director of the Mawson Institute and a member of grants evaluation panel of the European Research Council. Currently Prof Griesser is enjoying strong peer interactions by collaborating with dynamic, enthusiastic colleagues, including some of the world's top scientists in the two fields of plasma techniques and biomaterials surfaces, respectively, and exchanging ideas and reciprocal visits.

Upcoming Virtual Events

Appita Young Professionals Network (YPN) Interview Series (runs over 6 months). The next webcast is **The Power of Self-Directed Learning** on Wednesday 12th August. For further info: https://appita.com/training-development/webinars

The 2020 Appita New Speaker Competition. Applications close 21 August 2020. For further info: https://appita.com/events-activities/new-speakers-competition

Monash Virtual Open Day 2020. Saturday 29th Aug— Monday 31st Aug. For further info: https://www.monash.edu/open-day

Research Publications

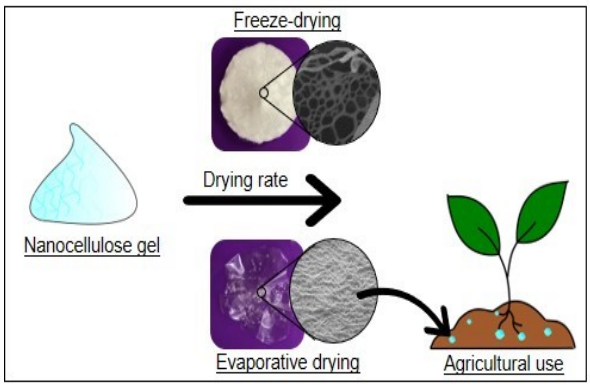
Selected articles recently published in Carbohydrate Polymers and Colloids and Surfaces A: Physicochemical and Engineering Aspects, demonstrating excellence of PALS Research Hub program.

1) Controlling the Properties of Nanocellulose Gels with the Extent of Carboxylation

We are pleased to share that our paper titled "Controlling the transparency and rheology of nanocellulose gels with the extent of carboxylation" has been recently published in Carbohydrate Polymers. The paper, authored by David Mendoza, Laila Hossain, Christine Browne, Vikram Singh Raghuwanshi, George P. Simon and Gil Garnier, describes how the optical and visco-elastic properties of carboxylated nanocellulose gels can be controlled by a one-shot TEMPO-periodate oxidation reaction. The study also highlights that TEMPO- periodate oxidised nanofibres (TPOF) are highly-oxidised with a high surface charge of -80 mV – the most stable CNF we have prepared so far. TPOF produces highly-transparent and viscous gels which are relatively stable at basic pH and high ionic strength. Freeze-dried TPOF gels also exhibit remarkable water holding capacity making it as an ideal green alternative to commercial superabsorbents. The team also explored the use of the highly transparent gel for red blood cells analysis, opening open new possibilities in diagnostics application.

Further reading: Mendoza DJ, Hossain L, Browne C, Raghuwanshi VS, Simon GP and Garnier G. 2020. **Controlling the transparency and rheology of nanocellulose gels with the extent of carboxylation**. Carbohyd Polym 245: 116566.

2) Engineering nanocellulose superabsorbent structure by controlling the drying rate



Nanocellulose Gel / Superabsorbent for Sustainable Agriculture. Every year, more than 70% of the earth's available freshwater is used for agriculture. In Australia, this industry accounts for 59% of the total water extractions each year. Superabsorbent polymers can be used in agricultural fields as water reservoirs, preserving soil moisture and supplying water as plant demands.

In this study, we engineer the structure of a novel superabsorbent made of nanocellulose as hydro-retentor material for sustainable agriculture. This is simply achieved by controlling the drying rate. The use of Nanocellulose Superabsorbents, green and 100% biodegradable, not only saves the farmers thousands of tonnes of water every year but also increases crop production yields and revenues.

Further reading: Barajas-Ledesma, Ruth & Patti, Antonio & Wong, Vanessa & Raghuwanshi, Vikram & Garnier, Gil. 2020. **Engineering nanocellulose superabsorbent structure by controlling the drying rate**. Colloids and Surfaces A: Physicochemical and Engineering Aspects. 600. 124943. 10.1016/j.colsurfa.2020.124943.

Farewell to Colleague

Dr Anil Vir

Last week we bid farewell to Dr Anil Vir, who is returning to India. Dr Vir joined BioPRIA as a post-doctoral research fellow in August 2019. He has been working with Dr Joanne Tanner and some of the postgraduate students on the lignin separation from the paper and pulp waste stream. We thank Anil for his contribution and wish him all success in his future endeavor!

Meet BioPRIA New Student!

Gloria Diaz

BioPRIA is delighted to welcome Gloria Diaz to our team. Gloria received her Bachelor's degree in Chemical Engineering in 2015 from the Industrial University of Santander in Colombia. She was part of the national program of COLCIENCIAS Young Researcher, working at the research group CENIVAM.

Gloria is now a PhD candidate at BioPRIA under the supervision of Dr. Joanne Tanner and Prof Gil Garnier. She is working on the production and separation of oligosaccharides from hardwood biomass. This project aims to innovatively apply engineering approaches to develop sustainable processes for the obtention of functional products from bioresources. It represents the possibility to implement biorefinery models in the existing industries.