

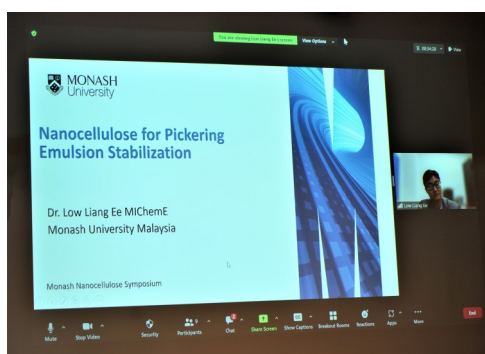
BioPRIA NEWSLETTER

July 2023

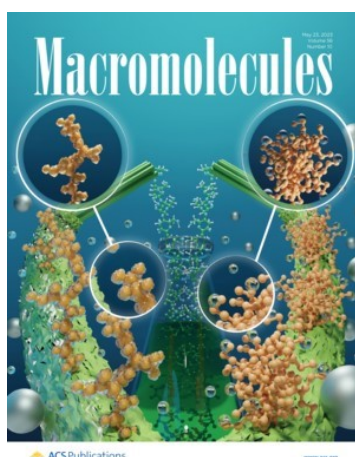
Monash Nanocellulose Symposium - Event Success!

On the 6th June 2023, BioPRIA hosted the Monash Nanocellulose Symposium at New Horizons, Clayton campus. The event was a great success and well-attended by academics, students and industry representatives.

The symposium featured exciting talks from BioPRIA researchers and networking opportunities for knowledge exchange. It showcased our five accepted papers in the 2023 TAPPI Nanotechnology Conference, which covered a wide range of topics, from nanocellulose characterisation to the development of CNC barrier films for packaging applications. It is also a privilege to hear from Dr. Liang Ee Low at Monash University Malaysia about his research on nanocellulose for pickering emulsion stabilisation.



Cover Feature



Synthesis of Superabsorbent Polyacrylic Acid-Grafted Cellulose Nanofibers via Silver-Promoted Decarboxylative Radical Polymerization
(Macromolecules **2023** 56(10), 3497-3506)

Research by Mendoza et al. has been featured on the cover journal of *Macromolecules*. The study validates a novel approach to graft polyacrylic acid (PAA) from cellulose nanofibers (CNFs). It also demonstrates that the Ag(I) catalyst loading can modulate the degree of branching, leading to new superabsorbent polymers for a wide range of applications. The link to the article is [here](#).

Conferences Highlights

PALS student, **Pallabi Sinha Roy** attended the **14th Advanced Polymers via Macromolecular Engineering Conference (APME 23)** in Paris on 23rd -27th April 2023. The APME conference is a major event in the field of polymer science, which covers range of topics such as: macromolecular/supramolecular engineering, sustainable/renewable polymers, self-assembly and interactions of polymers. Pallabi delivered a presentation on “Designing of photo-responsive polymers from renewable resources” in front of the academic and industry delegates from around the world. During her stay in Paris, she also visited the European Center of Biotechnology and Bioeconomy (CEBB) where URD-ABI-AgroParisTech located. She explored the labs and met with Prof. Florent Allais to discuss her ongoing research work.



From 12th to 16th June, **2023 TAPPI Nanotechnology conference** was held at Westin Bayshore in Vancouver, Canada. This conference focuses on renewable nanomaterials and provides exceptional opportunities to deliver technical values in this field and meet experts from all over the world. From BioPRIA, A/Prof. Warren Batchelor, Dr. Christine Browne, and PhD student Yasuaki Inoue attended this annual conference to present our research outcomes with the titles below.

- **A/Prof. Warren Batchelor:** “High-barrier plasticised cellulose nanocrystal film” (on behalf of Naghmeh Nasiri), “Barrier properties of nanocellulose films” (on behalf of Hans Cainglet)
- **Dr. Christine Browne:** “How electrolyte vary the suspension structure of cellulose nanocrystals”, “Controlling droplet contact angle with micropatterned nanocellulose films”
- **Yasuaki Inoue:** “Physical properties of spray-deposited nanocomposite sheets based on cellulose nanofibre and lignin particle”



The conference week started with 2 tours (one is to Bioproduct Institute of University of British Columbia, and the other is to an industrial company Noram BC Research Inc.) in the morning of Monday 12th, followed by nanocellulose workshops and keynote speech in the afternoon. In the technical presentations, which took place from the 13th to 15th, there were more than 100 talks and almost 50 posters with themes ranging from preparation/characterisation of nanocellulose and nanolignin to evaluation of their effects in various applications such as packaging, insulation, and biomedical products. Some technical talks focused on safety regulations of cellulose nanomaterials, suggesting the high expectations from the industry. In fact, many people from industrial companies having interests in renewable nanomaterials were present in technical presentations as well as product showcase. It is always great to have discussions and socialise with researchers from both academia and industry. We really look forward to coming back to the conference next year, which will be held in Atlanta, USA.

2023 GRC Recap and International Visit



Prof. Gil Garnier attended the **Biomass to Biobased Chemicals and Materials Gordon Research Conference (GRC)** in United States on 28 May – 2 June 2023. The GRC looked at how scientists and engineers can overcome, through transdisciplinary approaches, the fundamental challenges that the biorefineries are facing today. The conference aimed at gathering international experts to foster the development of sustainable biomass conversion process into valuable chemicals and materials. Here, Prof. Garnier delivered a presentation on “Engineering Plant Biomaterials for Smart Applications: Opportunities and Challenges”.

During his trip, Prof. Garnier also visited the European Center for Biotechnology and Bioeconomy (CEBB) and took the opportunity to catch-up with colleagues from URD-ABI. He is also a visiting Professor at AgroParisTech—URD ABI.

Summer Research Project Highlight by Josh Dillon, President - Monash Pilot Processes Team

Finding Value in Paper Waste: Fermentation Creates Lactic Acid for Bioplastics

Reimagining waste is crucial for building a circular economy, where we aim to minimize our reliance on primary resources. The key is to unlock the value of waste and use it as an alternative. One exciting area gaining momentum is the development of bioplastics, which can be derived from various industrial waste streams. Current research focuses on optimizing the processing conditions for producing lactic acid, the precursor to polylactic acid, a key bioplastic. However, scalability of the production process remains a challenge.

A recent summer research project conducted at BioPRIA aimed to produce and purify lactic acid from industrial wastewater from the pulp and paper industry. Two related objectives were set for the project: demonstrating value addition to waste on a larger scale and developing a procedure to demonstrate biological engineering and product recovery using the Monash Student Pilot Plant.

To achieve this, 30 L samples of simulated wastewater (commercial cellulose pulp resuspended in water) and industrial wastewater (filtered process water) were fermented with *Lactobacillus Rhamnosus* bacteria. Fermentation of the simulated cellulosic water proved successful, yielding up to 48 mg/L/h of lactic acid. While the fermentation of wastewater fell short (20 mg/L/h), it still showed value addition to the waste stream.

To increase lactic acid concentration following fermentation, a membrane pilot plant was used for product recovery. Filtering the fermented mixtures through ultrafiltration and reverse osmosis membrane circuit increased the relative concentration of lactic acid compared to other by-products.

This project showcases the viability of the pilot plant as a bio-product recovery system, enhancing the prospects of a circular economy. By utilizing sustainable resources that would otherwise go to waste, we can reduce our dependence on primary resources and move towards a more sustainable future.



Figure 1. the potential circular economy of polylactic acid derived from pulp and paper wastewater



Figure 2. operating the pilot plant to process the fermented lactic acid mixture

Latest Publications

Mendoza, D. J., Ayurini, M., Raghuwanshi, V. S., Simon, G. P., Hooper, J. F., Garnier, G. 2023. **Synthesis of Superabsorbent Polyacrylic Acid-Grafted Cellulose Nanofibers via Silver-Promoted Decarboxylative Radical Polymerization**. *Macromolecules*, 56(10), 3497-3506. DOI: [10.1021/acs.macromol.3c00431](https://doi.org/10.1021/acs.macromol.3c00431)

Nadeem, H., Naseri, M., Dehghani, M., Pazirofteh, M., Raghuwanshi, V., Garnier, G., Batchelor, W. 2023. **Spray Deposited Cellulose Nanofibril Films: A Recyclability Study**. *Waste and Biomass Valorization*. DOI: [10.1007/s12649-023-02137-0](https://doi.org/10.1007/s12649-023-02137-0)

Cainglet, H.E., Tanner, J., Nasiri, N. et al., 2023. **Rapid cellulose nanomaterial characterisation by rheology**. *Cellulose*, 30, pp. 4971-4982. DOI: [10.1007/s10570-023-05180-1](https://doi.org/10.1007/s10570-023-05180-1)

Nadeem, H., Dehghani, M., Miri, S. et al. **Highly hydrophobic and moisture barrier nanocellulose based films produced via spray deposition**. *Cellulose* 30, 5157–5170 (2023). DOI: [10.1007/s10570-023-05171-2](https://doi.org/10.1007/s10570-023-05171-2)

Browne, C., Hertaeg, M.J., Mendoza, D.J., Naseri, M., Lin, M., Garnier, G. and Batchelor, W., 2023. **Micropatterned cellulosic films to modulate paper wettability**. *Colloids and Surfaces A: Physicochemical and Engineering Aspects*, 656, p.130379.

See Kiat Wong; Muhamad Israq Amir Mohd; Ali Liang Ee Low; Janarthanan Supramaniam; Sivakumar Manickam; Tin Wui Wong.; Gil Garnier and Siah Ying Tang, **“Transforming the Chemical Functionality of Nanocellulose for Applications in Food Pickering Emulsions: A Critical Review”**, *Food Reviews International* (In press) (2023).

Abedin, Md Joynul; van der Schoot, Paul; Garnier, Gil; Majumder, Mainak, **“Nematic Transformation in Cellulose Nanocrystal Droplet Phase”**, *Langmuir*, 39 (17) 6142-6150 (2023).

Thulya Chakkumpulakkal Puthan Veettil, Diana Alves, Jitraporn Vongsvivut, Rosemary Sparrow, Bayden Wood and Gil Garnier, **“Characterization of freeze-dried oxidized human red blood cells for pre-transfusion testing by synchrotron FTIR microspectroscopy live-cell analysis”**, *Analyst*, 148, pp 1595-1602 (2023).

Welcome to BioPRIA!

We are pleased to welcome two new PhD candidates, **Anurag Tripathi** and **Darsan Haridas** to the BioPRIA team. Anurag will be working on developing novel and efficient platforms for paper diagnostics for a variety of applications, under supervision of Prof. Gil Garnier and A/Prof. Simon Corrie. While Darsan’s research project will focus on radical decarboxylation as an enabling technology for functional materials, with Dr. Joel Hooper, Prof. Gil Garnier and Prof. Florent Allais as his supervisors.

Conferences of Interest

ACS Fall 2023, San Francisco, 13-17 August 2023

[Register here](#)

Chemeca 2023, Auckland NZ, 1-3 October 2023

[Register here](#)

Appita New Speaker Competition Runoff Australia, BioPRIA-Monash University, 25 October 2023

[Apply here](#)

FVCCON23 – Appita Fibre Value Chain Conference, Melbourne, 23-24 November 2023

[Stay tune for more information](#)

Would your company like to collaborate and discuss any research opportunities with us?

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