SPEAKER

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BIOGRAPHY

Gil Garnier is Director of the Bioresource Processing Research Institute of Australia (BioPRIA) and Professor in Chemical Engineering, Monash University, Australia since 2005. He is also Director of the ARC transformation Hub-Processing Advanced Lignocellulosics (PALS). Previously, Gil was Team Leader/Senior Research Scientist at Kimberly-Clark (2000-2005) and Paprican Professor in Chemical Engineering, McGill University (1993-2000). His expertise is the application of (bio)polymers and Interfacial Engineering to biodiagnostics and lignocellulosic materials. His research team aims at developing novel paper biodiagnostics and implementing biorefineries based on green chemistry and sustainable processes. Gil (co)supervises 15 Ph.D. students and 6 Post docs/research associates. He has graduated 19 Ph.D. and 11 Masters students. He is founding Editor in Chief of “Frontiers in Chemical Engineering” and Editorial board member of “Cellulose, Bioresource”, “NPPJ” and “Appita Journal”. He published over 150 peer reviewed articles/book chapters and holds 15 patents, many of which used every day in commercial products.

LECTURE

How to engineer paper bio-diagnostics?

Raising the hypothesis that paper is over-designed for its current applications (communication, packaging and tissue) and that Kraft bleach pulp behaves virtually as pure cellulose can open a wide array of new-applications. Among those are paper bio-diagnostics. Cellulose is well known for the strength it provides to the tree, for its hierarchical structure that has led to nanocellulose innovation and to be hydrophilic and polar. However, how cellulose hydrophilicity and polarity can raise opportunity for innovation has not fully be sized. This is the topic of this presentation.

We have modelled, from first principles, the wicking kinetics of sessile droplets on paper and validated the model with various liquids. Modelling the kinetics of coffee ring formation with colloids suspensions also nicely matches our experiments with latex suspension. However, blood wicking on paper and their coffee ring formation behave completely differently; this is due to effects of protein adsorption combined with the biconcave shape and deformability of red blood cells. The interaction cellulose-proteins are strong and unique; these affect the behaviour of enzyme and antibody immobilized on paper for diagnostic applications.

The first part of the presentation will review the fundamentals controlling the protein-cellulose interaction. The second will present how cellulose-enzyme and antibody interactions has been engineered into novel biodiagnostics. Two examples are analysed. The Blood typing paper device (GLIF) highlights the importance of antibodies, while the Fibrinogen paper diagnostic focuses on enzyme-based diagnostics. A perspective on new concept and technology for paper biagnostics will conclude the presentation.