Beyond Green Substitution: Engineering Functional Architectures from Natural Rubber and Biomass

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Abstract

Current developments in green materials often focus on replacing petroleum-based resources with renewable alternatives. However, future sustainable materials should not only originate from renewable resources, but also introduce new structural concepts and functionalities. This presentation discusses recent developments in natural rubber and biomass-based materials from the perspective of structural and architectural design.

The first part presents a fully plant-based leather alternative derived from pineapple leaf fiber (PALF) and natural rubber. Unlike conventional artificial leathers that rely on multilayer synthetic structures, the developed material consists of a single-layer fibrous architecture in which natural rubber is integrated within a randomly oriented PALF network. The resulting structure provides flexibility, strength, tear resistance, and desirable tactile properties while maintaining high bio-based content.

The second part highlights uniaxially aligned foam structures based on natural rubber and biomass-derived components. Through structural alignment and process innovation, lightweight materials with improved structural integrity, dimensional stability, and rapid elastic recovery can be achieved.

Overall, the presentation emphasizes that the future of green materials lies not only in sustainable feedstocks, but also in the intelligent design of structure, morphology, and processing. By combining natural rubber with engineered biomass architectures, new opportunities can emerge for advanced sustainable materials with enhanced functionality and reduced environmental footprint.

References 1) S. Duangsuwan, P. Junkong, P. Phinyocheep, S. Thanawan and T. Amornsakchai, *Sustainability*, 15, 15400 (2023).

Biography (For Plenary, Keynote, and Invited Speakers)

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Personal History:

Taweechai Amornsakchai is an Associate Professor in the Polymer Science and Technology Program, Department of Chemistry, Faculty of Science, Mahidol University, Thailand. He is affiliated with the Center of Sustainable Energy and Green Materials and the Center of Excellence for Innovation in Chemistry (PERCH-CIC). He received his Ph.D. in Polymer Science and Technology from the Interdisciplinary Research Centre (IRC), University of Leeds, UK, in 1994.

His research interests focus on highly oriented fibers, including both synthetic and natural fibers, and their composites. Since 2010, his work has emphasized the utilization of pineapple field waste in Thailand, particularly pineapple leaves and stems, as sustainable resources for advanced materials. He developed an innovative mechanical method for extracting short pineapple leaf fibers and later expanded the research to include pineapple stem starch. His research covers applications in polymer reinforcement, biodegradable materials, functional composites, and fully bio-based leather alternatives.

Dr. Amornsakchai has published more than 50 peer-reviewed articles related to the utilization of pineapple field waste and sustainable materials. His work highlights the transformation of agricultural by-products into high-value functional materials with environmental and industrial significance. In recognition of his scientific contributions and innovations, he received the Mahidol University Prize for Excellence in Invention and Innovation in 2022.

Research Keyword (3-5 keywords use commas to separate each word):
Natural Rubber, Green Materials, Biomass Architecture, Bio-based Composites