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MSE 690 SEMINAR SERIES

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ARMS 1010



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“Advances in Bio-Based Polymers: Harnessing Ligno-Nanocellulose for Sustainable Material Innovations”

Abstract:

The non-renewable nature of crude oil and the imminent depletion of reserves are driving technological innovation toward the development of bio-based polymers to replace their petroleum-based counterparts. The use of green, renewable, and sustainable materials has become increasingly critical in the production of high-value products with minimal environmental impact. Natural polymers, particularly those derived from plant and animal biomass such as cellulose, hemicellulose, lignin, and chitin, are renewable resources that play a pivotal role in the circular economy.

Combining the unique properties of various natural polymers is key to developing a new generation of functional materials to replace traditional fossil-based ones. Nanosized cellulose materials, in particular, exhibit exceptional properties such as low density, high aspect ratio, and high modifiability. These properties, coupled with recent advances in energy-efficient and scalable production methods, make nanocellulose highly attractive for numerous high-performance applications. However, the successful integration of nanocellulose in these applications requires a thorough understanding of the interfacial phenomena that occur when these materials are combined with other bio-based polymer matrices.

This presentation will highlight the work of the Sustainable Bio-Based Materials lab at Auburn University, which focuses on understanding the structure-property relationships of bio-based materials to develop value-added products by fine-tuning surface chemistry and interactions among system components. Dr. Peresin will introduce ligno-nanocellulose and discuss the challenges related to its processing and characterization. An overview of her research platform will be provided, showcasing the development of ligno-nanocellulose-based solutions for emerging contaminant removal from water sources, composite materials for packaging, and additive manufacturing. Additionally, the talk will explore the creation of 3D structures for controlled release of active ingredients such as pesticides and agrichemicals, as well as emulsion formulations for coating applications, among other innovations.

Biography:

Maria Soledad Peresin, Ph.D., is an associate professor of Forest Biomaterials at Auburn University's College of Forestry, Wildlife, and Environment and is also affiliated with the Chemical Engineering Department. She is the leader and founder of the AU Sustainable Bio-Based Materials Laboratory, which was established in 2016. Peresin earned her Licenciata in Analytical Chemistry in 2007 from the Universidad Nacional del Litoral in Argentina and her Ph.D. in Forest Biomaterials from North Carolina State University in 2011. Afterward, she joined the High Performance Fibre Products Knowledge Team at VTT where she worked for 6 years. With over 20 years of academic and industrial experience, she specializes in biomass valorization for innovative product development. Peresin received the prestigious NSF Early Faculty CAREER award in 2021. She boasts a prolific publication record and has held leadership roles in various professional associations, including TAPPI and ACS, and is a member of the TAPPI Board of Directors.



School of Materials Engineering