College of Engineering
Department of
Mechanical & Industrial Engineering

The Robert W. Courter Seminar Series

3:00-4:00pm, Friday, September 9th, 2022

1221 Patrick F Taylor Hall

Ultrasonic-Assisted Processing and Joining of Polymer Composites

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Fiber-reinforced polymers, or composite materials, possess high specific modulus and strength, making them well-suited in several fields of applications where weight reduction is primordial, such as aerospace, automotive, maritime, energy, biomedical, and oil & gas. Their use can translate into important fuel consumption and CO_2 emission reduction, as well as cost savings. As we seek to develop more energy-efficient and cost-effective manufacturing and joining methods, there is a need to better understand relationships between process parameters, material properties, structural quality, and performance. In our laboratory, we are studying a combination of advanced composite materials (e.g., continuous fibers, fabrics, and meshes), including thermoset and thermoplastic matrices, as well as thermoset shape memory polymers. In particular, we are interested in uncovering multi-scale mechanisms behind ultrasonic processing and additive manufacturing, and exploring a range of out-of-autoclave methods (such as resin infusion) to design technology demonstrators. We employ multi-scale experimental approaches and computational methods to inform parameters selection. The main difference between traditional thermoset and thermoplastic polymers is that the latter soften and may be formed again when heated up above a certain temperature. Thermoplastic composites can therefore be joined through fusion bonding, otherwise known as “welding”, eliminating the use of mechanical fasteners. This seminar will present a general overview of ongoing research projects in our laboratory, then will focus on main outcomes related to ultrasonic-assisted processing of polymer composites, enabled through high-frequency, low-amplitude vibrations: i) ultrasonic welding, structural health monitoring, and repair of thermoplastic composite joints using multifunctional nanocomposites; ii) ultrasonic consolidation of layered thermoplastic composites; and iii) high-speed ultrasonic-assisted repair of thermoset composites for aerospace structures.

*Dr. Genevieve Palardy received her PhD degree in 2012 from McGill University (Montreal, Canada), as part of the Structures and Composite Materials Laboratory in Mechanical Engineering. After completing her PhD, she worked as a research associate at Bombardier Aerospace in the Composites Development Department (Montreal, Canada). From 2014 to 2017, she was a postdoctoral researcher in the Structural Integrity & Composites Group in Aerospace Engineering at the Delft University of Technology (Netherlands). Since 2017, she has been appointed as an Assistant Professor in the Department of Mechanical & Industrial Engineering at LSU. Her research themes involve understanding of process parameters-structure-performance relationships behind out-of-autoclave processing methods (e.g., ultrasonic-assisted processing, additive manufacturing) for thermoset and thermoplastic matrix composites. Dr. Palardy’s research has been funded by the LA Board of Regents, LaSPACE, NASA EPSCoR, NSF, and industry.