Sustainable Biopolymers: Towards Scalable Processing and Tailored Properties

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Abstract

The production, consumption, and disposal of polymers for consumer applications pose several problems for the environment, including carbon emissions and the persistence of microscale and nanoscale debris in ecosystems. In recent years, biopolyesters (e.g. Polybutylene adipate terephthalate) have emerged as environmentally friendly alternatives to petroleum-derived polymers, due to their biodegradability, and tailorable mechanical properties. Other biopolymer alternatives, such as polysaccharides (e.g. chitosan and cellulose ethers), are naturally abundant and self-assemble in cholesteric liquid crystals with a tailored photonic bandgap, opening new opportunities for the development of functional optical materials. However, the widespread adoption of these biopolymeric alternatives remains limited due to challenges in their large-scale synthesis and manufacturing. In this talk, we will discuss processing of these polymers through fast and open-air reaction schemes, and their integration in the development of stimuli-responsive materials. We will discuss how chemical factors such as molecular weight and repeat-unit chemistry affect chain mobility in solution-based and thermal manufacturing schemes. We will also discuss how interchain interaction can be leveraged to result in long-range order such as liquid crystal self-assembly, therefore enabling new advanced optical functionality. These relationships are expected to assist in the large-scale deployment of biopolymer-based functional materials with tailored structure and properties.

Short Biography

Cécile A. C. Chazot (she/her/hers) is the Julia Weertman Assistant Professor of Materials Science and Engineering at Northwestern University, where she leads the Sustainable Polymer Innovation laboratory (SPIn lab). Her research seeks to develop sustainable polymer-based materials, with an equal focus on environmental and societal impact. Her focus areas include fiber-based materials, biopolymers, large-scale processing, structural colors, and engineering education. She earned her Ph.D. in 2022 from the Department of Materials Science & Engineering (DMSE) at the Massachusetts Institute of Technology (MIT), under the supervision of Prof. A. John Hart, and a M.Sc. in Materials Science and Engineering from Mines Paristech (France). She is also a co-founder of the Materials Initiative for Comprehensive Research Opportunity (MICRO), a remote educational program to empower minoritized undergraduates to conduct research in materials science. Cecile's work lies at the interface of educational initiatives and innovation in materials and manufacturing, which led her to receive the Arthur Nowick Award and a Silver Graduate Student Award at the 2021 Materials Research Society (MRS) Fall Meeting.