Public Summary

Applicant: Georgia Institute of Technology

Principal investigator: Carson Meredith

Project title: Cellulose-Chitin Composites for Performance Advantaged Barrier Packaging Bioproducts

Project Objectives: This project will produce a performance-advantaged bioproduct packaging material that exceeds the oxygen barrier characteristics of a widely-used petroleum-derived commercial plastic film, poly(ethylene terephthalate) (PET). The new bioproduct will be based on a combination of biomass-derived cellulose nanocrystals and nanofibers, and chitin nanofibers. These renewable materials are derived, respectively, from woody biomass and shellfish food waste biomass feedstocks. The objective is to produce bioproducts that exceed oxygen barrier properties of PET, by using a scalable roll-to-roll coating process. The novelty of the PABPs lies in utilizing multiple layers of cellulose and chitin materials, which form dense, transparent films with good barrier properties. In addition the work will advance the state of the art by addressing other properties necessary for eventual commercialization in two application areas: (i) film-based food packaging and (ii) flexible protective film for printed electrochromic devices and displays.

Project description: The team will use a combination of high-throughput screening and roll-to-roll processing to explore film designs and produce prototypes based on the following steps:

1) Laboratory scale coating to rapidly identify optimal format and design of bioproducts.
2) Roll-to-roll slot-die coating to produce prototype bioproducts.
3) Production of prototypes with demonstrated improvement of at least 10% in oxygen barrier properties relative to PET film.
4) Optimization of composition and processing of products to address other key property requirements for two applications: (i) food packaging and (ii) electrochromic display packaging, including water vapor transmission, oxygen performance under elevated humidity conditions, metallization of the PABP for device printing, mechanical properties, and optical clarity.
5) Determination of costs to manufacture products and development of a commercialization and technology transfer plan.

If successful, this has the potential to spur revolutionary changes in packaging products that support a move towards replacement of petroleum-derived materials with biomass-derived materials. The work will support new product development for a significant sector of the U.S. economy at a critical juncture in its existence. The forest products industry has annual sales in excess of $200 billion, which is approximately 4 percent of the total U.S. manufacturing GDP. By expanding market opportunities in packaging, an important impact on U.S. manufacturing jobs is expected. The forest bioproducts industry has more than 900,000 employees, many in rural communities across the nation. The industry meets a payroll of approximately $50 billion annually and is among the top 10 manufacturing sector employers in 45 states. The work accomplished here will provide new market opportunities for the nascent, but rapidly growing cellulose nanomaterial and will provide incentives to establish chitin nanofiber manufacturing.