Soydan Ozcan, PhD
Energy and Environmental Sciences Directorate

Dr. Soydan Ozcan is a senior scientist in ORNL's Energy and Environmental Sciences Directorate and joint associate professor in the Mechanical, Aerospace and Biomedical Engineering Department at the University of Tennessee–Knoxville. He also serves as the thrust lead for development of bioderived polymer composites for additive manufacturing at ORNL. His research addresses the broad and vital issue of identifying novel, high-value biomaterials from biomass, along with viable processes for preparing biomaterials for composite and additive manufacturing applications. Dr. Ozcan is developing manufacturing techniques and exploring new materials to improve energy efficiency during composite manufacturing, decrease material waste, and improve material performance. He has actively initiated new programs and has been the principal investigator for over 30 R&D projects including research in the areas of fiber and composite manufacturing, composite recycling, and bioderived-materials additive manufacturing. Dr. Ozcan's team engages over 30 industrial partners and delivers research with direct applications to society. He has published nearly 80 papers; holds 18 issued and pending patents; has published 7 book chapters; and is an active speaker, having delivered more than 100 presentations and short courses on manufacturing of fibers and composites topics and research.

Intellectual Property

Silane-Modified Polyester Blends and Methods of Preparation; 16/110,138

Biomacromolecule Engineering by Soft Chain Coupling Technology, ID-201904306

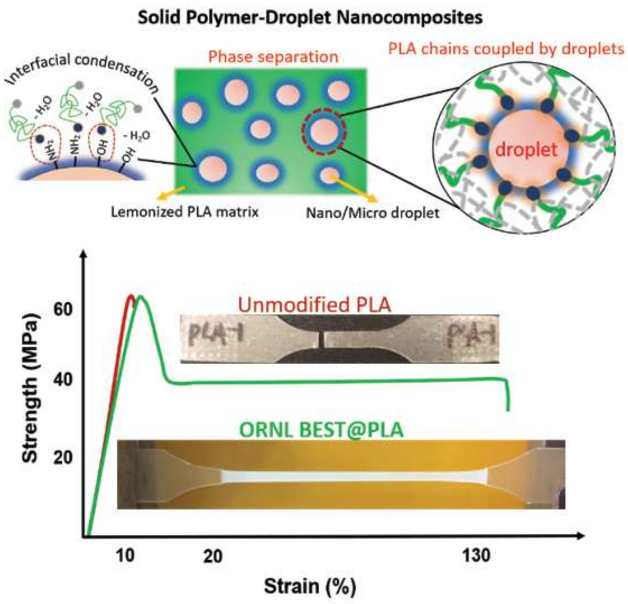
For more information, please contact
Nestor Franco,Ph.D.
Commercialization Manager
francone@ornl.gov
865-574-0534

BEST: Biomacromolecule Engineering by Soft Chain Coupling Technology

Problem: Poly(lactic acid) (PLA) is the most widely used bioplastic today. Its biodegradability, biocompatibility, high strength, and stiffness as a commodity polymer make PLA one of the most promising bioplastics under development. Its many application areas include but are not limited to biomedical devices, biodegradable films and packages, and 3D printing. However, PLA's brittle nature is a major barrier to its adoption in much wider application areas.

Solution: The BEST approach dramatically improves the ductility and toughness of PLA via a novel industry-friendly soft-coupling technology based on small droplets and chain end/tail modification. This technology is realized by a scalable, environmentally friendly process that uses only nontoxic additives and a melt-phase process to achieve the desired droplet-in-polymer microstructures, referred to as polymer–droplet composite. The droplets work as a unique topological modifier to manage the topological defects of chain entanglement networks. As a result, with minimal loading of modifiers (<1.5 wt%), the modified PLA offers significant improvements in toughness as well as processability without sacrificing the material's mechanical strength.

Impact: The production capacity of the biobased-polymer industry is projected to triple, from 3.5 million tons in 2011 to nearly 12 million tons in 2020. As the fastest-growing segment of this market, PLA is expected to account for over $6.5 billion because of its use in packaging, biomedical devices, composites, additive manufacturing, and other areas. Overcoming the issue of brittleness without sacrificing other valuable mechanical properties would revolutionize the already rapidly growing PLA industry. Improvements in mechanical performance would not only extend existing markets, but also enable new applications such as films and packages and penetration into new polymer markets. The new materials derived using the BEST approach exhibit outstanding mechanical toughness and processability, which are of great value for its broad applications.



Publications

- X. T. Meng, N. A. Nguyen, H. Tekinalp, E. Lara-Curzio, and S. Ozcan, "Supertough PLA-Silane Nanohybrids by In Situ Condensation and Grafting." *ACS Sustain. Chem. Eng.*, 2018; 6 (1): 1289–1298.