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Cullen College of Engineering

AMUNDSON LECTURE 2025

Ionic Compatibilization of Plastics to Reduce Environmental Impacts

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We simultaneously associate plastics with both waste in the form of massive landfill requirements and a tendency to escape into sensitive ecosystems and also as a potential solution to energy and climate crises in the form of cheap, lightweight, safe batteries and other energy devices. In both cases, however, one attribute of polymers is simultaneously its greatest flaw and a tremendous opportunity in terms of improved performance: processibility. The inability to recycle plastics is at least in part rooted in the array of chemically dissimilar commodity plastics on the market and our inability to recycle such a mixed stream. In this talk, I will demonstrate the tremendous utility of electrostatic interactions in reducing the potential environmental impacts of plastics. For example, we have recently demonstrated that incorporating even a single charged group per polymer chain causes highly immiscible polymers to form homogeneous blends with high mechanical strength. Similar electrostatic attractions are so strong as to force conjugated (conducting polymers) to form high solids loading solutions that have shown great utility as battery binders.

Rachel Segalman's research involves controlling the hierarchical structure and thermodynamics of energy-relevant polymers including water separation membranes, polyelectrolytes, and semiconducting and bioinspired polymers. This includes a desire to understand the molecular-scale design rules and synthesis that lead to self-assembly and mesoscale architectures that control macroscopic properties such as ionic, thermal and electronic conductivity as well as surface activity. Applications include microelectronics, electrolyzers and batteries, separation membranes, and marine anti-fouling coatings. Segalman earned a Bachelors degree with Highest Honors in Chemical Engineering from the University of Texas (1998) and a Ph.D. in Chemical Engineering from UC Santa Barbara (2002). She is the Associate Director of the UT/UCSB/LBL EFRC: Center for Materials for Water and Energy Systems and the co-editor of the Annual Reviews of Chemical and Biomolecular Engineering. Segalman is a member of the DOE Basic Energy Sciences Advisory Committee (BESAC) and of the Science and Technology Committee for the Lawrence Livermore National Security, and a co-author of the recent National Academies study, "Chemical Engineering: Challenges and Opportunities in the 21st Century." She serves on the National Academies Committee on International Security and Arms Control (CISAC). Segalman received the E.O. Lawrence Prize from the U.S. Department of Energy, the Andy Acrivos Award for Professional Progress from AIChE, the Journal of Polymer Science Innovation Award, and the Dillon Medal from the American Physical Society. She is a Fellow of the American Physical Society and the Royal Society of Chemistry, the American Institute of Chemical Engineers, and was elected to the American Association for the Advancement of Science, the American Academy of Arts and Sciences and the National Academy of Engineering.

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Amundson's legacy for ChemE:
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