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Title: Polymer Architecture as a Design Tool: Leveraging Branching to Tune Function and Performance

Abstract: Polymer properties are governed not only by chemical composition, but also by macromolecular architecture. Linear, branched, and hyperbranched polymers composed of identical repeat units can exhibit markedly different solubility, viscosity, and responsive behavior. This work emphasizes polymer branching as a structural design parameter for exploring how macromolecular architecture influences material properties. Controlled radical polymerization, particularly reversible addition–fragmentation chain transfer (RAFT) polymerization, enables modular and well-defined access to polymers with tunable degrees of branching and composition. Using this synthetic framework, linear and hyperbranched polymer systems have been prepared to investigate structure–property relationships across several application areas. These efforts include thermoresponsive polymers, metal-chelating polymers, and emerging antimicrobial polymer platforms. In thermoresponsive block copolymers, systematic comparisons between linear and hyperbranched architectures demonstrate that branching, block order, and monomer distribution influence the location and breadth of thermal transitions and associated self-assembly behavior. In metal-chelating polymers, comparisons between architectures provide insight into how branching affect solution size, aggregation and metal-binding behavior. In addition, ongoing work on hyperbranched antimicrobial polymers highlights the synthetic versatility of branched architectures and establishes a foundation for future studies aimed at understanding how macromolecular structure impacts biological activity. Collectively, these studies underscore the importance of polymer architecture as a tunable variable for guiding material behavior and support its continued exploration in the design of functional polymer systems for biomedical, environmental, and materials-focused applications.

Bio: Dr. Calvo was born and raised in Dusseldorf, Germany. She moved to the United States at age 18 to attend Lindenwood University in St. Charles, Missouri, where she received her B.S. in Chemistry with concentration in Biochemistry. After graduating from Lindenwood, Dr. Calvo pursued her doctoral degree in Organic Chemistry at the University of Florida. Her graduate research, under the guidance of Dr. Ken Wagener and Dr. Brent Sumerlin, focused on the synthesis of well-defined functionalized polymers for biomedical applications. After receiving her PhD, Dr. Calvo accepted an industrial research position at a Biotech company in San Antonio, TX. Her research in this position focused on the applications of polymer chemistry to create advanced wound care products and antimicrobials. After two years in industry, Dr. Calvo realized that her true passion lies in academic teaching and research. After working as a Chemistry Lecturer at Texas A&M University San Antonio for a year, Dr. Calvo accepted a position as Assistant Professor of Chemistry at Nova Southeastern University in 2018. After five years at NSU, Dr. Calvo moved to Kansas State University in 2023 where she currently serves as Assistant Professor of Chemistry. Her research focuses on creating novel polymeric materials to solve real-world problems including antimicrobials, drug-delivery and water purification.