THE MATERIALS SCIENCE AND ENGINEERING DEPARTMENT
SPRING 2024 COLLOQUIUM SERIES PRESENTS:

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Co-sponsored by PPG and MRSEC

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Amphiphilic dendritic hybrid block copolymers (HBCs) for theranostic nanomedicine

Nanoparticles created from amphiphilic hybrid block copolymers (HBCs) have been upheld as promising candidates for various applications, including bioimaging, therapeutic delivery and diagnosis. Comprised of chemically distinctive blocks of differing architectures, these unique polymer frameworks possess properties that surpass those of conventional amphiphilic polymers. However, a lack of synthetic feasibility has hindered the widespread adoption of amphiphilic HBCs due to challenges with distinct solubility of the blocks, steric effects of the branched block on copolymerization and purification of end products.

Herein, we report the use of aqueous reversible addition-fragmentation chain transfer (RAFT) polymerization to form amphiphilic hybrid block copolymers (HBCs) and assess their potential as biomaterials for theranostic application. Comprised of chemically distinctive blocks of differing architectures (i.e., dendritic and grafted/linear), these unique polymer frameworks were strategically designed to self-assemble and form nanoparticles ideal for simultaneous bioimaging and therapy. The synthesis, physicochemical characterization, and in vitro cell viability of a library of dendritic HBCs and their resulting nanoparticles are discussed. Microscopy (TEM) and dynamic light scattering (DLS) analysis support aqueous dispersion, resulting in polymeric nanoparticles of < 120 nm size. The resulting polymer hybrids and their nanoparticles displayed minimal cell toxicity and potential for dual imaging and therapy. Results indicate that these polymers and their resulting nanoparticles possess properties that surpass those exhibited by conventional amphiphilic polymers. This study exemplifies the effect of polymer topology on nanomaterial properties and expands the design space of RAFT polymerization in biomedical research.

A native of Memphis, Tennessee, **Davita L. Watkins** obtained her Bachelor of Science in Chemistry and Anthropology from Vanderbilt University in Nashville, Tennessee. After working briefly as a Lead Chemical Analyst for a bioanalytical company, she obtained a Ph.D. in Chemistry from the University of Memphis under the tutelage of Dr. Tomoko Fujiwara. As a doctoral candidate, she developed and established multi-step synthetic methods for a series of stimuli-responsive molecules and polymeric materials, demonstrating potential applications in phase transfer catalysis, catalytic control, and drug delivery. As a postdoctoral researcher at the University of Florida in Gainesville, Florida, with Dr. Ronald K. Castellano, she developed novel self-assembling organic materials for photovoltaic applications. In 2014, she began her independent academic career at the University of Mississippi. She joined the faculty at The Ohio State University in the Summer of 2022 as a tenured Associate Professor of Chemistry with a joint appointment in the Department of Chemical and Biomolecular Engineering. Her research interests focus on using noncovalent interactions to construct nanostructured polymeric materials. Her research has garnered numerous awards, such as the Oak Ridge Associated Universities (ORAU) Ralph E. Powe Award, a National Science Foundation CAREER Award, a Young Investigator Award from the Polymeric Materials: Science and Engineering (PMSE) Division branch of the American Chemical Society (ACS) and a Rising Star Award from ACS Women Chemists Committee (WCC). She is an Associate Editor for ACS Omega and resides on several editorial and research advisory boards.

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