Chemical tools for controlling the topology of polymer networks

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All polymer networks have cyclic molecular topologies that critically impact their properties. Nevertheless, these features have been difficult to quantify and control. Informed by classical crossover experiments in physical organic chemistry, we have developed experimental methods for the precise counting of cyclic topologies (loops) of various order in polymer networks. These studies have enabled new theoretical advances pertaining to elasticity and the gel point, and have inspired new stimuli-responsive materials that leverage topology as a design principle.

Jeremiah Johnson conducted undergraduate research Washington University in St. Louis where he received a Bachelor of Science degree in biomedical engineering with a second major in chemistry. He then moved to Columbia University where he received a doctorate in chemistry. He then held a Beckman Post-doctoral Fellowship at the California Institute of Technology under the guidance of Professors David A. Tirrell and Robert H. Grubbs. He has been a professor at the Massachusetts Institute of Technology (MIT) since July 2011. He is also a member of the MIT Program for Polymers and Soft Matter as well as the Koch Institute for Integrative Cancer Research.

Johnson has received a 2019 ACS Cope Scholar Award, the 2018 Macromolecules-Biomacromolecules Young Investigator Award, the 2018 Nobel Laureate Signature Award for Graduate Education, a Sloan Research Fellowship, the Air Force Young Investigator Award, the Thieme Journal Award for Young Faculty, the DuPont Young Professor Award, the 3M Non-tenured Faculty Award, and an National Science Foundation CAREER award. In recognition of his teaching, he was awarded the 2018 MIT School of Science Undergraduate Teaching Prize.

Professor Johnson’s research group is focused on the development of methods and strategies for macromolecular synthesis and surface functionalization. Research focuses on molecular design in three primary areas: nano-scale materials synthesis, macro-scale materials synthesis, and development of new chemical methods for modifying interfaces between bulk and nanoscale objects (surface chemistry).

Information: https://z.umn.edu/JohnsonJeremiah

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