UNIVERSITY OF DELAWARE

CHEMICAL & BIOMOLECULAR ENGINEERING

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EXPLORING THE ROLE OF MACROMOLECULAR LOOPS IN TAILORING THE PROPERTIES OF SOFT MATERIALS

The presence of free ends is largely responsible for the remarkable flow properties of entangled polymers because of the associated large conformational entropy of the macromolecular chains and ability to easily randomize their direction. This is reflected on the transient entanglement network that is characterized by a rubbery plateau modulus, and the mechanism of disentanglement to leads to macroscopic motion. An important question with significant consequences in biology (e.g., genome folding) pertains to the dynamic response of loopy structures, i.e., macromolecules without free ends, which are known as ring or cyclic polymers. Here, we briefly review the field and show that, unlike their linear counterparts, moderately entangled ring polymers do not exhibit a plateau modulus. We then focus on recent developments that include the ability to tailor the melt rheology polymeric networks by adding loopy structures, the extraordinary low-stretch-rate thickening due to ring interlocking, the development of normal stresses and the use of rings as effective gelling effects. We close this journey into loopy macromolecules by presenting current challenges and in particular the need to explore the role of molar mass on the rheology and the dynamics in solution.