Random Walks in Polymer Science

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To a researcher dealing with long chain molecules, the term “random walk” signifies one of the most common starting descriptors to understand the chain conformation of long string-like molecules. However, the title I have chosen is more to describe the path my students and I have taken during the past two decades to solve a variety of interesting problems in polymer science; some of which actually have to do with countering the strong tendency of polymer chains to adopt random-coil conformations. Constructing polymer molecules that are not long string-like objects but are more like highly branched trees possessing a “branch-upon-branch topology”, has been one of our major preoccupations; in this context, we have developed novel methods to prepare such highly branched polymers that are called “hyperbranched polymers (HBPs)”, examined the effect of branching density on their chain conformation, created and explored core-shell type HBPs, examined the curious case of Janus (two-faced) HBPs, etc. A more recent preoccupation of ours has been to develop strategies to resist the strong tendency of polymer chains to adopt random-coil conformations and consequently generate specifically folded conformations by the use of weak non-covalent interactions between periodically spaced segments along the polymer backbone. This journey has led us to explore the use of charge-transfer interactions, solvophobic exclusion, metal-ion coordination, alkylene segment crystallization, etc., in an effort to get to the yet-elusive goal of translating the ordering in solution on to the solid state.

In this talk, I shall describe some of these selected explorations during our random walks that provide us with the most joyous moments of discovery.