Fundamental Kinetic Studies of Living Radical Polymerization (LRP) and Fascinating Surface Materials Created by LRP

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Controlled radical polymerization, so-called living radical polymerization (LRP), has attracted growing attention as a powerful method for synthesizing well-defined polymers with predictable molecular weights and narrow molecular weight distributions. LRP is a useful synthetic tool, but only if appropriate reaction conditions are established on the basis of mechanistic and kinetic understanding. This seminar will comprehensively survey mechanisms and kinetics of LRP. Basic theory describing the polymerization rate and molecular weight distribution, which holds for all LRP systems, will be discussed. The rate constant of the key reaction of LRP (activation reaction) will also systematically summarized in relation to the structures of capping agents and polymers in several important LRP systems.

Concentrated polymer brushes will be presented as new materials created by LRP. Because surfaces play a critical role in many important properties as an interactive interface to the external phase, surface modification is one of the most useful applications of LRP. Our research group used LRP for surface-initiated graft polymerization to obtain polymer brushes with the highest graft densities ever achieved, which are one order of magnitude higher than those of conventional semi-dilute brushes. Such so-called concentrated polymer brushes take on extremely extended conformations, affording many unique properties and widespread applications. The synthesis, properties (such as separation and biocompatibility), and applications of concentrated polymer brushes will be presented.