

New Families of Living Radical Polymerization Using Organic Catalysts: From fundamental chemistry to Macromolecular Design

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Living radical polymerization (LRP) is a powerful method for synthesizing well-defined, low-polydispersity polymers. We recently developed new families of LRP that utilizes iodine as a capping agent and organic molecules as catalysts. We developed two mechanistically different systems. These systems are the first LRP systems to use non-metal catalysts and are termed RTCP (reversible chain transfer catalyzed polymerization) and RCMP (reversible coordination mediated polymerization) on the basis of their new reaction mechanisms. The catalysts include inexpensive organic compounds such as amines, phosphines, and even non-toxic vitamins. RTCP and RCMP are amenable to a wide range of monomers encompassing all of the three important monomers for radical polymerization (methacrylates, acrylates, and styrene), acrylonitrile, and various functional monomers. Diblock and triblock copolymers, star polymers, and polymer brushes on solid surfaces are also obtainable. RCMP is also unique in that it can be induced by not only thermal heating but also photo-irradiation. RTCP and RCMP use only inexpensive compounds and are free from metals. The facile operation and accessibility to a large variety of polymer designs are greatly beneficial in a variety of applications. The chemistry and applications of these polymerizations will be presented.

