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Ring Opening Polymerization: New Catalysts Lead to New Polymeric Architectures

The stereoregularity of polymers has a major effect on their physical properties. For poly(α -olefins) and, in particular, polypropylene, the desired polymer is the isotactic variety. In the past six decades, efforts have been invested in developing of catalysts that would afford this variety in its highest degree of regularity.

Poly(lactic acid) – PLA – is prepared by the catalytic ring opening polymerization (ROP) of lactide. Lactide has two stereogenic centers. Isotactic, syndiotactic, heterotactic (as well as atactic) PLA may be formed by choice of the lactide monomer: homochiral-, racemic- or meso-LA, and choice of catalyst – most commonly a metal complex. The most desired form of PLA is the isotactic variety, and the combination of the two enantiomeric isotactic strands – PLLA + PDLA, either as a physical mixture or as a copolymer improves the crystallinity due to formation of a stereocomplex.

Importing structural motifs from the propylene polymerization catalysts regime to the lactide polymerization catalysts regime is tricky, considering the variety of metals, the importance of chain-end control, and the ease of polymeryl exchange between active species in the latter. Yet, some corollaries may be beneficial.

In this presentation, some of our recent efforts in this field will be described, including: the design of polydentate ligands and the introduction of new catalysts, mechanistic studies relating to polymeryl exchange, and the synthesis of copolymers with accurate microstructures.