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Advances in Heterothallic Catalyst Design Reactivity Patterns

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INTRODUCTION

With sustainability at the forefront of current polymerization research, the normally abundant, cheap and low toxic main group metals on Earth are attractive candidates for catalysis. Main group metals have been used in a wide range of polymerizations, from classical alkene polymerization to the synthesis of new bio-derived degradable polyesters and polycarbonates *via* ring-opening polymerization and ring-opening copolymerization. This tutorial review focuses on efficient polymerization catalysts based on group 1, group 2, zinc, and group 13 metals. Key mechanistic pathways and catalyst development are discussed, including tailored ligand design, heterothallic cooperatively, binary systems, and careful selection of polymerization conditions. All of these can be used to fine-tune the acidity of the metal Lewis and the polarity of the metal-alkyl bond. On the effects of common environmental chemicals on bone, from basic molecular insights to clinical implications.

DESCRIPTION

A truly sustainable plastic requires renewable raw materials combined with efficient post-consumer production and recycling processes. Some of the most useful degradable materials are aliphatic polyesters, polycarbonates, and polyamides, often produced by ring-opening polymerization using organometallic catalysts. Although the development of ligands has been extensively studied, heterothallic catalysts often have significantly improved activity and selectivity compared to monometallic catalysts. Compounds offer similarly promising but understudied strategies.

Poor waste management and uncontrolled consumption underpin the current paradigm of plastic use which has been shown to be unsustainable in the long term. Sexuality and versatility suggest that even the concept of a plastic-free society is unsustainable. A growing number of answers to this conundrum include research efforts focused on developing more sustainable plastics. Written by a trained chemist, this report reflects a journey of academic discovery that has led to the recognition of the importance of improving and enabling the wider system in which plastics exist. Initially, our focus was on the developing catalysts, as they are a key driver of sustainability by improving the efficiency and ease of polymerization. Metal catalysts with different ligand structures and incorporated metals have been developed to produce common polyesters such as poly (lactic acid) and polycaprolactone. The central themes of this work were stereo control, efficiency and versatility. These reports feature emphases on the end of life and physical properties of polymers, which were increasingly important themes as work shifted toward new methods of incorporating functionality in polymers produced by ring-opening polymerization.

CONCLUSION

The first two rely upon the exploitation of olefin metathesis to functionalize polyesters or polyether, and the third involves the manipulation of ring-opening polymerization equilibrium to enable selective monomer recovery from polyester. Our foundational work on 1, 3-dioxolan-4-one monomers is then discussed because this emerging class of molecules offers a distinct synthetic pathway toward functional polyesters, both conventional and novel. This backbone allows access to polyesters that are normally difficult to synthesize. This is because polymerization is driven by co-controlled extrusion of small molecules. Following these polyester-focused highlights, a foundation for ongoing work is presented. This means that polymer sustainability needs to be viewed from a systems-level perspective that includes economic and social factors along with environmental considerations. Material Design must be driven by practice, and it must involve key stakeholders from academia, industry.

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