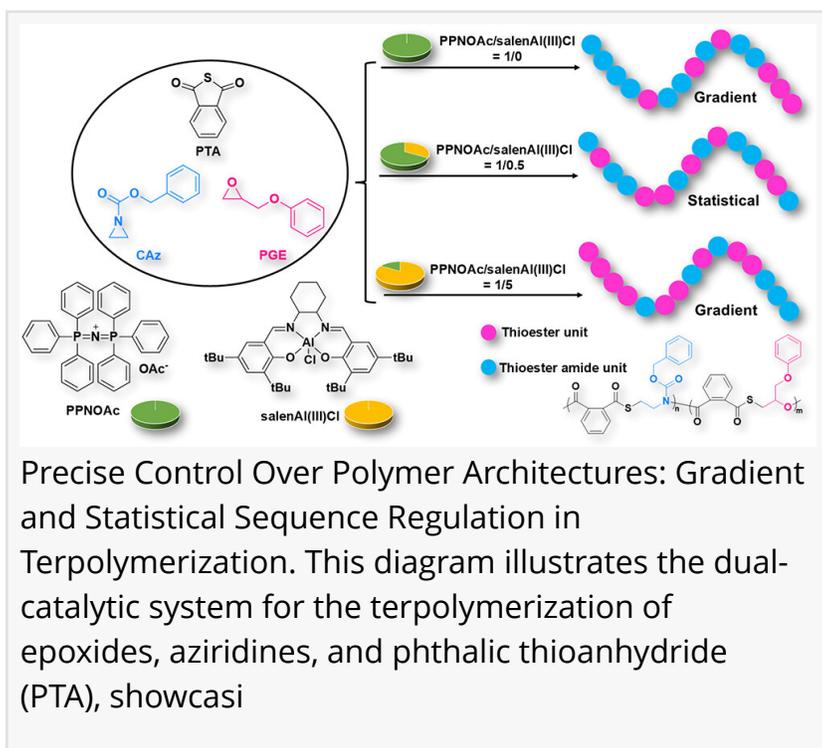


# A new era in polymer chemistry: Achieving unprecedented control in terpolymerization

GA, UNITED STATES, December 27, 2025 /EINPresswire.com/ -- The precise control over monomer sequences in polymers is revolutionizing material science, enabling the design of polymers with specific, programmable properties. A new study introduces an innovative catalytic system for the synthesis of sequence-controlled poly (thioester amide) using a dual-catalytic approach. By manipulating catalyst combinations, the researchers achieve precise control over polymer microstructures, including gradient, statistical, and inverse gradient architectures. This breakthrough opens new possibilities for creating polymers with tailored properties for advanced applications in fields like nanomedicine, adaptive biomaterials, and responsive systems.



Polymer sequence control is critical for developing advanced materials with precise properties tailored to specific applications. Traditional methods of polymerization often struggle to achieve the level of control needed to fine-tune polymer architecture. Recent advances in catalytic precision engineering are breaking this limitation, offering new avenues for creating polymers with well-defined sequence structures. These innovations could significantly impact industries that rely on custom polymer properties, such as data storage and nanomedicine. Based on these challenges, or due to these issues, there is a need for further in-depth research to refine and expand these catalytic methods.

The new research, published in Precision Chemistry, showcases a novel approach to sequence-controlled polymerization through a dual-catalytic system involving PPNOAc and salenAl(III)Cl catalysts. Conducted by researchers from Northwestern Polytechnical University in China and Monash University in Australia, this study offers a detailed look into how dynamic catalyst manipulation can regulate monomer sequences in polymers. By combining epoxides, aziridines,

and phthalic thioanhydride in a well-controlled terpolymerization process, the team achieved unprecedented precision in polymer synthesis.

The researchers developed a dynamic catalytic system capable of manipulating the polymerization pathways of different monomers with high precision. By adjusting the catalyst stoichiometry, they could switch between gradient, statistical, and inverse gradient polymer architectures, a feat previously unattainable with traditional methods. This was particularly evident in the successful terpolymerization of epoxides, aziridines, and phthalic thioanhydride, where reactivity ratios were carefully controlled, allowing for the creation of polymers with varying sequence distributions. The research also demonstrated that varying the catalyst combinations could optimize the thermal properties and structural integrity of the resulting polymers, opening new doors for industrial applications where precise material properties are essential.

In this study, the authors mention that “this new method provides a robust platform for engineers and material scientists to design polymers with digital precision, offering tailored properties that can be leveraged in advanced technologies like adaptive materials and intelligent systems. The ability to precisely control polymer sequences will undoubtedly enhance the functionalization of synthetic polymers in multiple fields.”

The implications of this work are vast, as it enables the synthesis of polymers with specific sequences that directly correlate with their material properties. This level of precision could lead to innovations in biomedical devices, where the functionality of materials can be engineered at the molecular level. Furthermore, the ability to control polymer microstructures will benefit industries focused on advanced electronics, data storage, and environmental sustainability, providing new solutions for creating smarter, more responsive materials that adapt to changing conditions. |

## References

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