Chinese Journal of
POLYMER SCIENCE

PREFACE

https://doi.org/10.1007/s10118-026-3786-3
Chinese J. Polym. Sci. **2026**, *44*, 1957–1958

Special Topic: Distinguished Young Scholars in Polymer Science

The landscape of polymer science is being reshaped by a new generation of innovative researchers, and China stands at the forefront of this transformation. It is with great pleasure that we present this special topic of the *Chinese Journal of Polymer Science* (CJPS), dedicated to "Distinguished Young Scholars in Polymer Science." This topic, comprising four research articles and four comprehensive reviews, serves as a vibrant testament to the rapid elevation of research quality and the pioneering spirit of young Chinese scientists. Their work not only addresses fundamental challenges but also charts new directions for the development of advanced polymer materials.

The four research articles in this topic present innovative molecular design strategies for dynamic polymer networks, smart hydrogels, and stimuli-responsive photonic materials. Yan, Cheng, and coworkers introduced mechanically interlocked vitrimers (MIVs) by embedding slidable pseudorotaxane cross-links into vinylogous urethane-based covalent adaptable networks. Compared to a control network with fixed cross-links, MIV containing ones exhibit a higher glass-transition temperature while maintaining comparable ductility and demonstrating superior toughness. At elevated temperatures, the slidable cross-links markedly accelerate stress relaxation. Crucially, owing to the associative nature of vinylogous urethane exchange, the mechanically bonded cross-links remain topologically constrained on the polymer chains throughout the relaxation process, clearly distinguishing MIVs from defect-mediated dual-dynamic designs. This work establishes a novel topology-engineering paradigm for smart multi-dynamic polymers.

Tian *et al*. addressed a fundamental challenge in supramolecular chemistry by designing supramolecular polymer networks (SPNs) that integrate both crown ether-based and pillararene-based host-guest interactions. The resulting material, SPN-EF, synergistically leverages the advantages of the two recognition motifs, delivering balanced and markedly improved mechanical properties while preserving outstanding self-healing ability and stimuli responsiveness. This strategy offers a compelling blueprint for the development of next-generation multifunctional supramolecular materials.

Zhao, Ni, and coworkers have developed autonomous shape-memory hydrogels by systematically incorporating hydrophobic acrylate comonomers with varying aliphatic chain lengths into poly(acrylic acid)/Ca^{2+} systems. Their results reveal a striking dichotomy: short alkyl chains disrupt polymer aggregation and eliminate timed recovery, whereas longer alkyl chains form reinforcing hydrophobic domains that simultaneously enhance mechanical integrity and extend the onset time. The optimized copolymer hydrogel achieves a tensile strength of 5.25 MPa and a maximum onset period of 800 min—representing 16.7-fold and 35-fold improvements, respectively, over the homopolymer hydrogel. This molecular modulation strategy not only deepens our mechanistic understanding of phase-separation-driven shape memory but also establishes a versatile platform for functionalizing hydrogels without compromising temporal responsiveness.

Zeng, Yao, and coworkers addressed a critical limitation in cellulose nanocrystal (CNC)-based photonic materials by developing an LCST-free thermochromic strategy. The authors exploit the temperature-dependent helical twisting power (HTP) of a cholesterol derivative (Chol-6) in conjunction with its thermally activated steric hindrance effect. A water-soluble prepolymer bearing Chol-6 side chains was co-assembled with glycerol and CNCs to produce flexible films with vivid structural color. The optimized film exhibits a remarkable 64 nm redshift upon heating from 25 °C to 80 °C. Mechanistic investigations reveal a competitive interplay between the temperature-sensitive HTP and thermally activated steric hindrance, uncovering previously unexplored dual roles of chiral compounds as thermo-responsive steric disruptors and chiral twist inducers.

The four review articles provide authoritative overviews of rapidly evolving fields at the intersection of polymer science and advanced functional materials. Li *et al*. addressed the pressing demand for polymer film-based dielectric capacitors capable of stable operation at extreme temperatures, driven by applications in underground oil and gas extraction, electrified transportation, and space exploration. While the commercial benchmark biaxially oriented polypropylene can only withstand up to 105 °C, this review summarizes recent progress in all-organic dielectric systems, establishing correlations between multi-level structures and high-temperature capacitive energy storage performance, analyzing charge transport mechanisms, and introducing materials informatics strategies for molecular design.

Liu *et al*. turned to the biomedical frontier, presenting three nanomaterial strategies for cancer immunotherapy: surface-adaptive nanomaterials that respond dynamically to physiological cues for prolonged circulation and controlled intratumoral activation; antigen-engineering nanoplatforms that enhance tumor immunogenicity and convert "cold" tumors into "hot" ones; and TME-modulating

nanomaterials that alleviate immune suppression through targeted delivery, cytokine neutralization, and gene-level reprogramming. Together, these approaches provide a multifaceted framework for reinvigorating antitumor immune responses.

Guo *et al*. summarized recent progress in intrinsically stretchable organic optoelectronic devices—including OPDs, OPTs, OPVs, OLEDs, and OLECs—focusing on molecular engineering and composite strategies for semiconductor active layers, with promising applications in wearable electronics, electronic skin, and health monitoring.

Zhang, Ren, and workers highlighted polymer-integrated covalent organic frameworks (polyCOFs), which seamlessly blend the crystalline porosity of COFs with the flexibility and processability of polymers, paving the way for applications in catalysis, energy storage, sensing, and biomedicine.

These contributions vividly illustrate the creativity and scientific depth that define China's young polymer scientists. We extend our heartfelt gratitude to all authors and reviewers, and hope this special topic will inspire further collaboration and innovation within the global polymer community.

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July 2026

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