

Special Topic on Porous Polymers

Porous polymers have emerged as a prominent frontier in contemporary polymer science. This is not only because they expand the structural boundaries of synthetic macromolecular materials, but more importantly because they provide a uniquely powerful platform for precisely controlling matter and energy at the molecular scale. Encompassing covalent organic frameworks (COFs), conjugated microporous polymers (CMPs), porous organic polymers (POPs), and polymers of intrinsic microporosity (PIMs), these materials integrate permanent porosity, modular chemical design, tunable electronic structures, and, in some cases, long-range order within a single framework. The combination of molecular programmability and framework-level complexity has opened unprecedented opportunities in energy conversion, chemical separation, environmental remediation, and advanced devices.

Beyond their practical promise, porous polymers hold considerable intellectual significance. They embody a powerful design philosophy: molecular building blocks, linkage chemistry, pore environment, and framework topology can be orchestrated to regulate mass transport, charge migration, host-guest interactions, and interfacial reactivity across multiple length scales. As the field continues to mature, the central challenge is shifting from simply constructing new porous skeletons to establishing foundational principles that connect structure with function, precision synthesis with scalability, and fundamental chemistry with real-world application.

This Special Topic on **Porous Polymers** in *Chinese Journal of Polymer Science* brings together 18 contributions, including both reviews and original research articles, that collectively reflect the rapid evolution of the field. Four additional papers related to this topic will appear in regular issues. Although diverse in scope, these works converge on several deeply interconnected themes: the invention of new synthetic methodologies, the pursuit of precise structural and topological control, the elucidation of structure-property relationships across multiple dimensions, and the translation of porous polymer platforms into scalable technologies and integrated devices.

One prominent direction highlighted in this topic is the continued reinvention of synthetic methodology. Several contributions feature solvent-free, microwave-assisted, and dynamic covalent approaches. These methods not only expand the synthetic toolbox for porous polymers but also address long-standing challenges in efficiency, crystallinity, conjugation, and scalability. Collectively, these studies reflect an important transition in the field from exploratory framework construction toward more

precise, sustainable, and application-oriented synthetic methodologies.

A second major theme is the growing recognition that structure in porous polymers is not a static descriptor but a dynamic determinant of function. Small variations in framework topology, regioisomerism, or dimensionality can exert disproportionate effects on charge transport, pore accessibility, host-guest interactions, and excited-state behavior. The studies assembled in this issue offer compelling examples of how topological isomerism, molecular isomer design, and dimensional modulation can profoundly influence photocatalytic activity and sensing performance. Such insights point to a deeper conceptual shift: framework architecture is increasingly viewed as an active design parameter that can be leveraged to manipulate reaction landscapes, transport pathways, and local energetic environments. In porous polymers, geometry has become chemistry by another means.

Energy-related applications also occupy a central position in this collection. Several contributions highlight recent advances in porous polymers for solar-energy conversion, photocatalysis, proton transport, and electrochemical devices, while also addressing critical issues such as framework stability under operating conditions. These studies illustrate the growing importance of porous polymers as integrated platforms in which light harvesting, charge separation, molecular transport, and catalytic function can be synergistically coupled within a single framework.

Equally striking is the breadth of applications beyond energy science. Porous polymers are proving increasingly powerful in molecular separations, environmental remediation, and soft functional architectures. Membrane-based microporous polymers continue to challenge the conventional trade-off between permeability and selectivity in demanding hydrocarbon separations. Functionally tailored porous frameworks are being developed for the efficient capture of hazardous ions and pollutants, while hierarchically structured porous polymer systems are enabling solar-driven desalination and coupled mass-energy harvesting. At the same time, progress in porous fibers and flexible porous architectures reflects an important expansion in material format and functionality, opening new opportunities in smart textiles, thermal regulation, and biomedical engineering. These advances reveal that porous polymers are no longer defined solely by porosity, but by their ability to integrate porosity with chemical intelligence and structural hierarchy.

Taken together, the contributions in this Special Topic

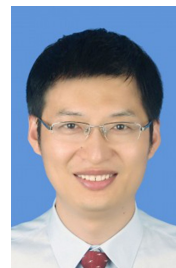
reflect a field that is moving beyond the synthesis of high-surface-area materials toward a broader science of controlled transport and reactivity in polymeric porous media. Porous polymers are increasingly understood not simply as high-surface-area materials, but as programmable framework systems for regulating the behavior of molecules, ions, electrons, and excitons in confined and chemically addressable environments. Looking ahead, some of the most exciting opportunities lie in unifying synthetic precision with scalable production, correlating framework structure with operando performance, enhancing long-term robustness, and integrating porous polymers into sophisticated devices and industrial processes.

We are deeply grateful to all the authors for their outstanding contributions to this Special Topic and to the reviewers for their insightful evaluations and suggestions. We also thank the editorial team of *Chinese Journal of Polymer Science* for their dedication and support in organizing

this Special Topic. We hope that this collection will not only provide a timely snapshot of recent progress, but also stimulate deeper thinking and future innovation in this rapidly advancing area.



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