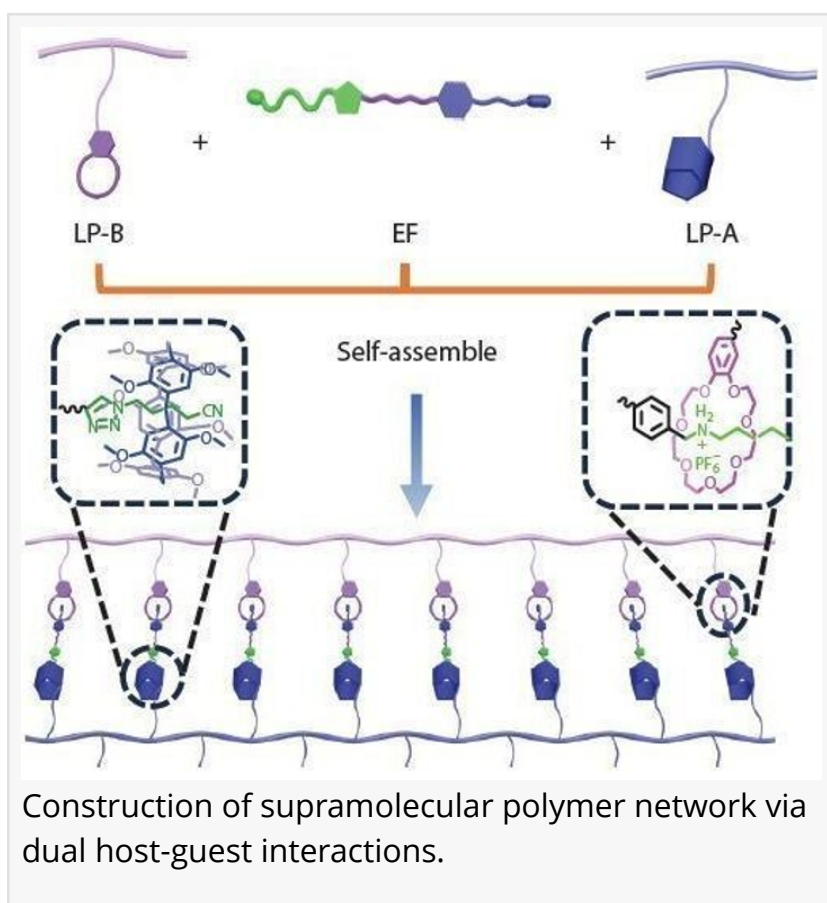


Supramolecular polymer networks get a dual-host boost for better toughness

FAYETTEVILLE, GA, UNITED STATES, August 31, 2026 /EINPresswire.com/ -- Researchers have developed a new class of dynamic polymer materials that seamlessly combine high mechanical strength with the ability to self-heal. By ingeniously integrating two different types of non-covalent interactions—or host-guest recognitions—within a single network, the team has created a material that overcomes the traditional trade-off between rigidity and flexibility. This innovative approach not only enhances the material's overall toughness and stiffness but also preserves its dynamic properties, such as stimuli-responsiveness and self-healing capabilities, marking a significant step forward in the design of advanced, sustainable materials.



[Traditional polymer materials](#), linked by strong covalent bonds, offer excellent mechanical stability but are difficult to recycle or repair. Conversely, supramolecular polymers, which are held together by reversible non-covalent interactions, are dynamic and can self-heal, but often lack the mechanical robustness needed for practical, real-world applications. This long-standing challenge has motivated scientists to explore ways to reinforce dynamic materials without sacrificing their unique adaptive properties. The key lies in the strategic design of the cross-linking network. Based on these challenges, the development of new structural paradigms that can integrate and balance both mechanical strength and dynamic functionality requires in-depth investigation.

Now, a team of researchers from Jiangxi University of Science and Technology and Northwestern Polytechnical University, led by Prof. Wei Tian, has reported (DOI: [10.1007/s10118-025-3499-z](https://doi.org/10.1007/s10118-025-3499-z)) a

novel solution. Published in the [Chinese Journal of Polymer Science](#) on January 15, 2026, their work details a new supramolecular polymer network (SPN) that leverages dual host-guest interactions—a synergy between pillararene and crown ether chemistry—to achieve an exceptional balance of mechanical properties and dynamics.

The core innovation lies in the use of two distinct macromolecular building blocks and two small-molecule crosslinkers. One system utilizes a rigid pillar[5]arene (P5) host and an alkyltriazole (TAPN) guest, while the other employs a flexible benzo-21-crown-7 (B21C7) host and an ammonium salt (DAS) guest. By combining both in a single network, named SPN-EF, the researchers achieved what single-interaction networks could not. While the SPN based solely on pillararene showed high strength but limited stretchability, and the crown ether-based network had high stretchability but lower strength, the dual-network SPN-EF exhibited the best of both worlds. It demonstrated a high Young's modulus of 30.29 MPa and a toughness of 41.98 MJ·m⁻³, comparable to the strongest system, while maintaining a high strain at break of 610%. The resulting gels were also highly dynamic, showing rapid self-healing within minutes and reversible gel-sol transitions in response to heat, potassium ions, or a competitive chemical agent, highlighting the versatility of the cross-linking strategy.

The authors explained that the synergy is key to the material's success. "By combining the strong binding of the rigid pillararene with the flexible, responsive crown ether, we've essentially created a network that is both tough and dynamic," they said. "The rigid components provide the structural framework for strength, while the softer components absorb energy and allow for movement. It's a modular approach that lets us finely tune the mechanical properties by simply adjusting the host-guest partners, which is a powerful tool for designing new functional materials."

This research opens new avenues for the design of advanced materials in fields demanding both durability and adaptability. The unique combination of strength, self-healing, and stimuli-responsiveness makes this new SPN a promising candidate for next-generation soft robotics, protective coatings, and biomedical devices. For instance, it could be used to create artificial skin or flexible sensors that can repair themselves after damage, significantly extending their lifespan. Furthermore, the principle of using synergistic dual host-guest interactions provides a generalizable platform that could be expanded with other macrocycles and guests to create a diverse library of high-performance, sustainable materials tailored for specific applications.

References

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