



ADVERTISEMENT



Get e-Alerts



Cite



Share



Jump to

ARTICLE | May 3, 2024

Supramolecular Templatation of Entanglements and Their Spectroscopic Detection in Polymer Elastomers

Fu-Sheng Wang, Benjamin J. Kruse, John C. Dickenson, and Aleksandr V. Zhukhovitskiy*



Access Through Your Institution

Other Access Options



Supporting Information (1)

MacromoleculesCite this: *Macromolecules* 2024, 57, 9, 4016–4023<https://doi.org/10.1021/acs.macromol.3c02207>

Published May 3, 2024 ▾

Copyright © 2024 American Chemical Society

[Request reuse permissions](#)

Article Views

1596

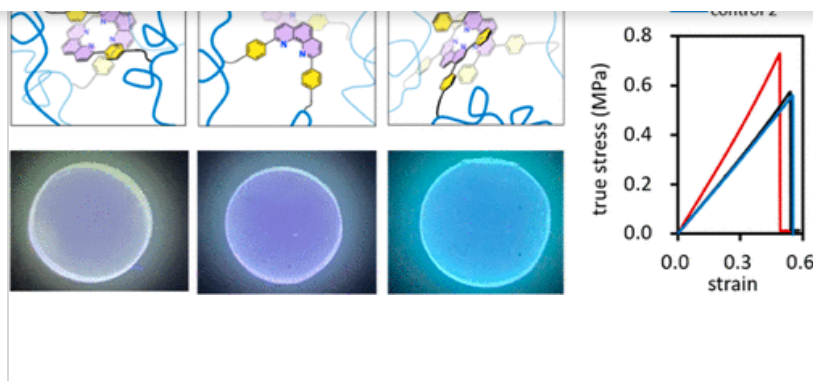
Altmetric

6

Citations

6

[Learn about these metrics](#)



Trapped entanglements—topological cross-links among polymer chains in a network—are fundamental to polymers and have been correlated with mechanical properties like toughness, critical for virtually any application of soft materials. Yet, although the concept of polymer entanglement has been around over 80 years, entanglement topology–property relationships remain ill-defined because we lack methods to experimentally install and quantify entanglements with precise topologies. Here, we use supramolecular templates based on phenanthroline-copper(I) complexes to install into poly(methoxyethyl acrylate) elastomer-trapped entanglements whose topology is programmed by the complex geometry. Compared to control materials, we observe 17% diminished swelling and 29% enhanced modulus, with only 0.75 mol % of the entanglement template or 1.5 mol % of the ligand. Moreover, we discovered that fluorescent phenanthroline-based exciplexes formed selectively when entanglement-templating complexes were used, which could in the future enable detection and direct quantification of supramolecular templated entanglements.

Copyright © 2024 American Chemical Society

Subjects ⓘ

Elastomers Ligands Mathematical Methods Nucleic Acid Structure Polymers

Read this Article

To access this article, please review the available access options below.

Recommended



Access through Your Institution



Purchase Access

Read this article for 48 hours. Check out below using your ACS ID or as a guest.

Purchase Access

[Restore my guest access](#)



Log in to Access

You may have access to this article with your ACS ID if you have previously purchased it or have ACS member benefits. Log in below.

Login with ACS ID

Supporting Information

The Supporting Information is available free of charge at <https://pubs.acs.org/doi/10.1021/acs.macromol.3c02207>.

- Materials and methods, experimental procedures, supplementary figures, and spectral characterization ([PDF](#))

Spectroscopic Detection in Polymer Elastomers00
views0
shares0
downloads**Supplementary Information****Supramolecular templation of entanglements and their spectroscopic detection in polymer elastomers**

Fu-Sheng Wang, Benjamin J. Kruse, John C. Dickenson, and Aleksandr V. Zhukhovitskiy*

Department of Chemistry, University of North Carolina at Chapel Hill, 101 South Road, Chapel Hill, North Carolina 27514, United States

*alexzhuk@email.unc.edu

1.	MATERIALS AND METHODS	S1
1.1.	Purchased materials	S1
1.2.	Analytical methods	S1
1.3.	Swelling ratio test	S4
1.4.	General experimental information	S4
2.	EXPERIMENTAL PROCEDURES	S5
2.1.	Synthesis	S5



Share

 Download**Terms & Conditions**

Most electronic Supporting Information files are available without a subscription to ACS Web Editions. Such files may be downloaded by article for research use (if there is a public use license linked to the relevant article, that license may permit other uses). Permission may be obtained from ACS for other uses through requests via the RightsLink permission system:

<http://pubs.acs.org/page/copyright/permissions.html>.

Cited By**Citation Statements** beta

powered by **scite_**

This article is cited by 6 publications.

1. Shunli Wang, Yinsheng Li, Limei Tian. Highly Tear-Resistant Recyclable Carbon Fiber Reinforced Composites Relying on Woven Cross-Linked Polyurethanes. *Nano Letters* **2025**, 25 (16) , 6606-6613.
<https://doi.org/10.1021/acs.nanolett.5c00606>

2. Erin C. Krist, Benjamin J. Kruse, John C. Dickenson, Aleksandr V. Zhukhovitskiy. Supramolecular Templation of Entanglements in Organogels. *Macromolecules* **2024**, 57 (16) , 7878-7883.
<https://doi.org/10.1021/acs.macromol.4c00343>

3. Gavin Irvine, Konstantinos Myronidis, Fulvio Pinto, Maciej Kopeć. Highly Entangled Hydrogels by Photoiniferter-Mediated Polymerization. *Angewandte Chemie* **2025**, 137 (17)
<https://doi.org/10.1002/ange.202421970>

4. Gavin Irvine, Konstantinos Myronidis, Fulvio Pinto, Maciej Kopeć. Highly Entangled Hydrogels by Photoiniferter-Mediated Polymerization. *Angewandte Chemie International Edition* **2025**, 64 (17)
<https://doi.org/10.1002/anie.202421970>

5. Koki Iwasaki, Yutaka Matsuo. Fabrication of Elastic Color-Changing Films—Elastomer Films Incorporating Mechanochromic Fluorenylidene–Acridane. *Molecules* **2025**, 30 (8) , 1761.
<https://doi.org/10.3390/molecules30081761>

6. Fu-Sheng Wang, Leah M. Kosovsky, Erin C. Krist, Benjamin J. Kruse, Aleksandr V. Zhukhovitskiy. Trapped entanglements in polymer networks: formation and characterization. *Trends in Chemistry* **2024**, 6 (8) , 447-458.
<https://doi.org/10.1016/j.trechm.2024.05.005>

[Download PDF](#)

Partners



ACS Publications
Most Trusted. Most Cited. Most Read.



1155 Sixteenth Street N.W.
Washington, DC 20036
Copyright © 2025
American Chemical Society

About

About ACS Publications
ACS & Open Access
ACS Membership
ACS Publications Blog

Resources and Information

Journals A-Z
Books and Reference
Advertising Media Kit
Institutional Sales
ACS Researcher Resources
ACS Publishing Center
Privacy Policy
Terms of Use

Support & Contact

Help
Live Chat
FAQ

Connect with ACS Publications

