

Topology: Next Dimension in Molecular Engineering

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Biography:

Prof. Zhang currently serves as an Associate Professor at Fudan University. Previously, he held the position of Zijiang Outstanding Young Professor at East China Normal University from 2020 to 2025. Liang got both bachelor and master degree from Fudan University under supervision of Prof. Zhan-ting Li and Danwei Zhang, he then joined Prof. David Leigh group in Manchester and finished his Ph.D. on the synthesis of molecular knots and links. Currently, Prof. Zhang's group works on the area of *Molecular Nanotopology* and *Molecular Nanotechnology*, mainly focusing on the synthesis of molecularly woven materials through high order topologically complex building blocks and probing the underlying physical mechanisms behind biological and artificial molecular machines via different single-molecule techniques. Prof. Zhang joins the Advisory board of *Chem* and *Chemical Science* in 2023 and serves as editors of *Chinese Chemical Letter*. The detailed publication can be found at his group website: www.chemnanotopology.com

Abstract:

Molecular Nanotopology,¹ a rapidly emerging independent research field, is now receiving recognition in its own right. Topological entanglements appear abundantly throughout nature—from knotted DNA and proteins to the intricate organization of chromosomes, yet often without any obvious functional necessity, raising fundamental questions about evolution's hidden design language. Topology is not merely a structural curiosity; it represents an entirely different dimension of molecular information that complements and transcends conventional chemical connectivity.

Pioneered by Sauvage, Stoddart and Leigh, the innovative research on molecular nanotopology is attracting the attention of many scientists from different fields, expanding its boundaries at a considerable rate of knots.² Progress made in this area during the past three decades has been not only in the rational design and practical syntheses of increasingly topologically complex molecules, but also the exploration of the unique properties associated with their topological features. By leveraging topological entanglement as an independent control parameter, chemists have begun to access functions and properties that are otherwise difficult or impossible to achieve through conventional molecular design.

In this talk, we will introduce our approach to making topologically complex molecules, particularly the stereoselective/enantioselective synthesis of high-order knots and links. Furthermore, we probe the consequences of molecular-level knotting and catenation via a range of single-molecule techniques that are typically applied to biomolecules.³ Through understanding the implications of topology in molecules, we are able to harness the unique dynamics and topological effects for the construction of functional materials. Thus, as molecular nanotopology comes of age, it opens a new dimension for designing and building molecules and molecular materials, precisely where molecular nanotechnology is transforming the nanoworld and stepping into the nanogalaxy.⁴

References:

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