Easy-To-Make Multi-Function Supramolecular Polymers Enabled by A Naturally Tailored Small Molecule

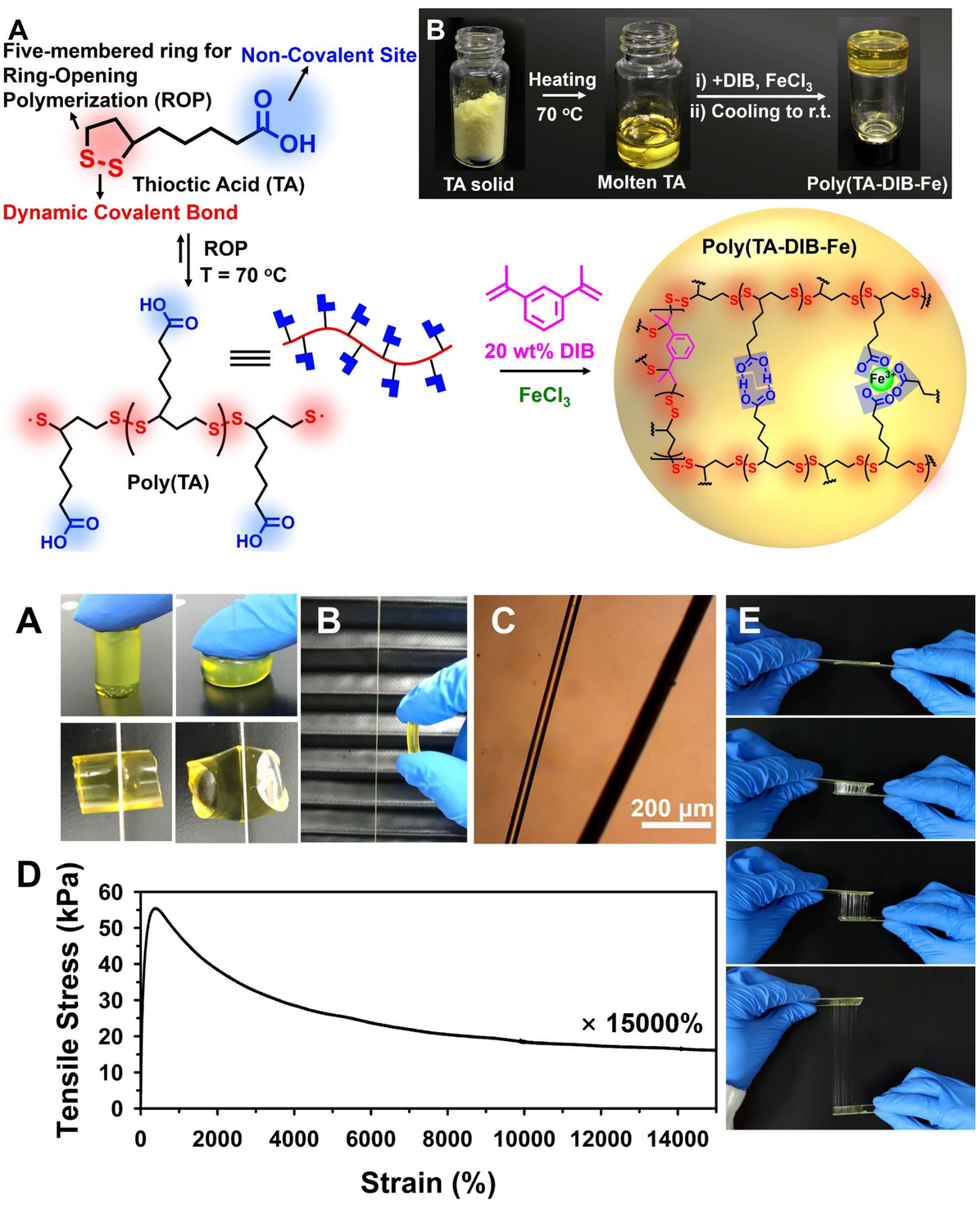
Qi Zhang[1,2], Yuanxin Deng[1,2], Chen-Yu Shi[1], Da-Hui Qu[1]*, Ben L. Feringa[1,2]*, He Tian[1]*

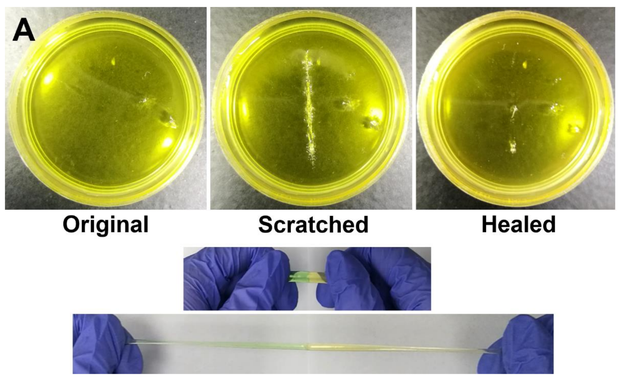
[1]Feringa Nobel Prize Scientist Joint Research Center, School of Chemistry and Molecular Engineering, East China University of Science and Technology, 130 Meilong Road, Shanghai, 200237, China
[2]Centre for Systems Chemistry, Stratingh Institute for Chemistry and Zernike Institute for Advanced Materials, University of Groningen, Nijenborgh 4, 9747 AG Groningen, The Netherlands

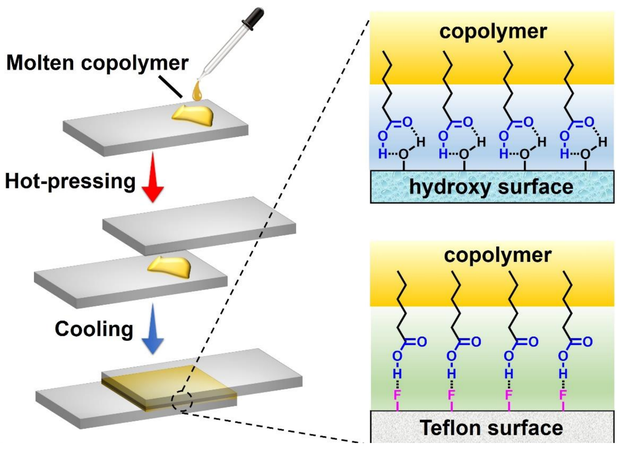
Email: dahui_qu@ecust.edu.cn; b.l.feringa@rug.nl; tianhe@ecust.edu.cn

Polymeric materials with integrated functionalities are required to match their ever-expanding practical applications, but there is always a trade-off between complex material performances and synthetic simplification. A simple and effective synthesis route is demonstrated to transform a small molecule of biological origin, thioctic acid, into a high-performance supramolecular polymeric material, which combines processability, ultrahigh stretchability, rapid self-healing ability, and reusable adhesivity to surfaces. Meanwhile, we also disclose a strategy that directs the hierarchical self-assembly of this small molecule into a highly ordered supramolecular layered network. By combining the unique dynamic covalent ring-opening-polymerization and an evaporation-induced interfacial confinement effect, we precisely direct the dynamic supramolecular self-assembly of this simple small molecule in a scheduled hierarchical pathway, resulting in a layered structure with long-range order at both macroscopic and molecular scales.

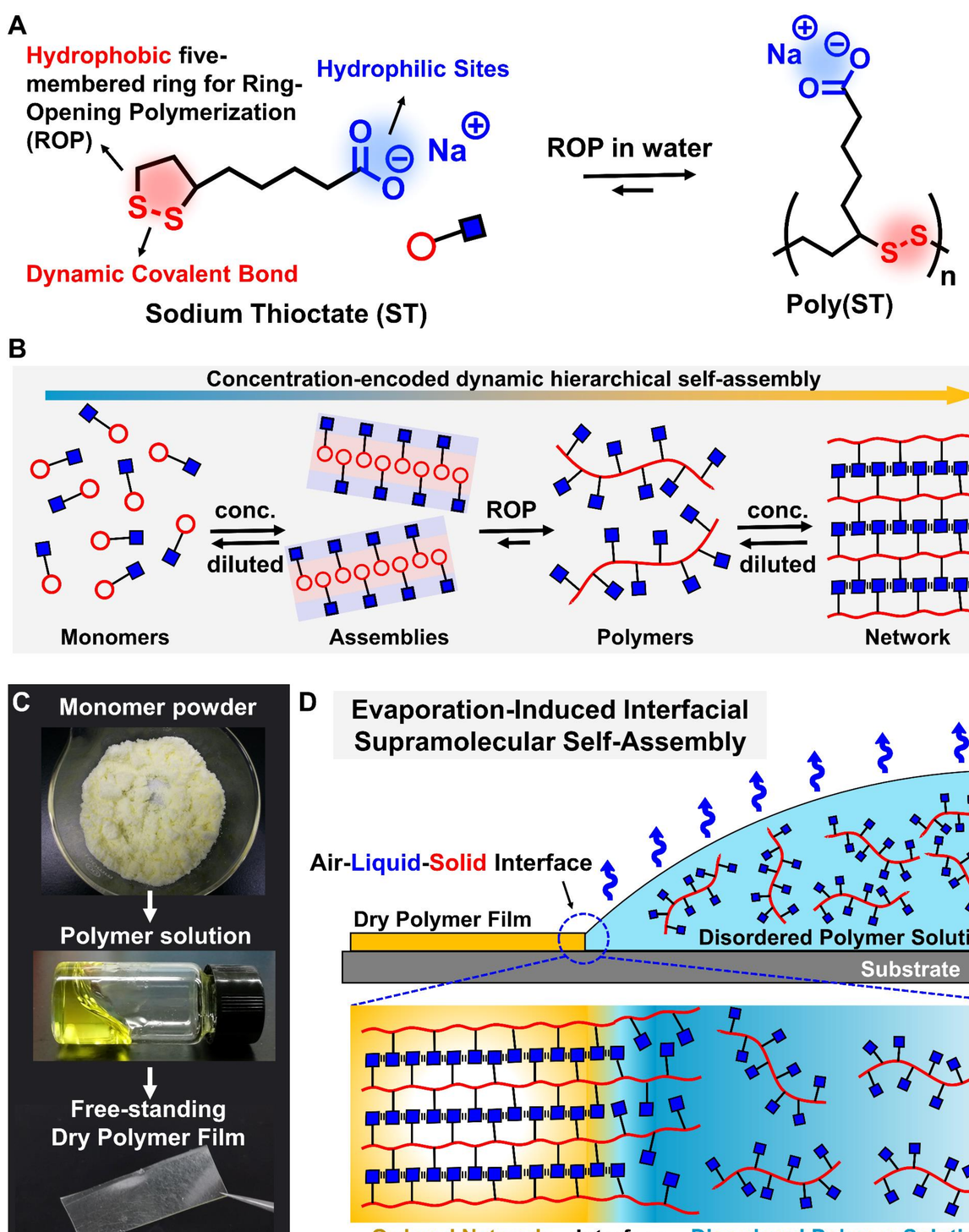
Supramolecular Elastomers

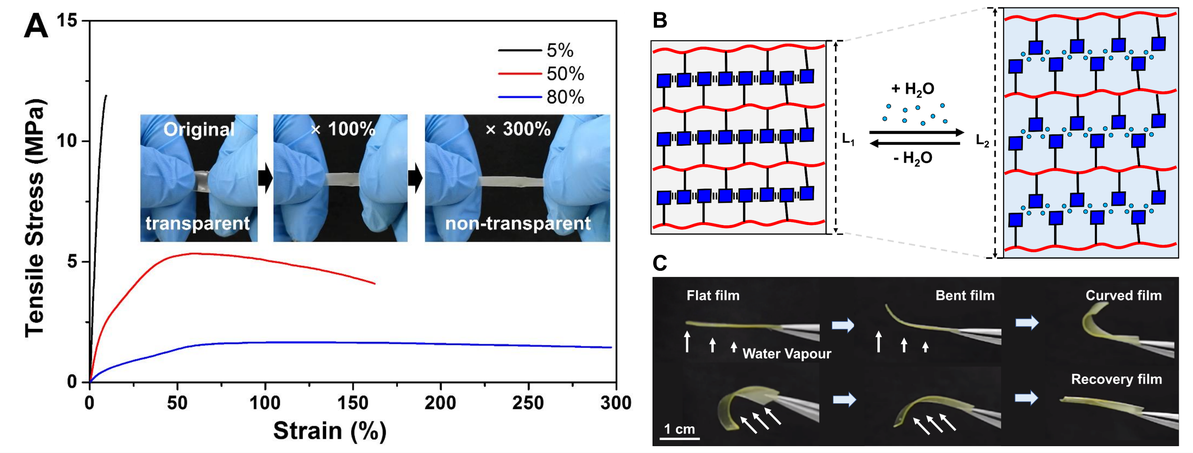






Supramolecular "Glasses"





Q. Zhang, C. Y. Shi, D.-H. Qu,* Y. T. Long, B. L. Feringa,* H. Tian,* Science Advances, 2018, 4, eaat8192.

Q. Zhang, Y. Deng, B. L. Feringa,* H. Tian, D.-H. Qu,* et al. J. Am. Chem. Soc. 2019, 141, 12804-12814.