The Rise and Promise of Artificial Molecular Machines in Polymer Chemistry and Materials Science

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The rise and promise of artificial molecular machines allow chemists to explore biomimetic control and functions in a nanoscale world. This presentation will discuss recent advances in the design and precision synthesis of enthalpically and entropically demanding polyrotaxanes bearing densely charged units courtesy of radical chemistry. I aim to develop a chemically and electrochemically redox-driven polyrotaxane synthesizer in order to control the exact number of rings installed onto a polymeric chain. I have designed and synthesized polymers with two molecular pumps attached at both ends of a polymeric chain, which acts as a collecting chain for multiple cationic rings. I have demonstrated that polyrotaxanes with a controlled number of rings can be produced through repetitive redox cycles using chemical reagents or a supply of electricity without generating and accumulating waste products. Recent progress on developing an automated polyrotaxane synthesizer and the expansion of the polymer scope will also be discussed, demonstrating great promises of applying artificial molecular machines in polymer chemistry and materials science.

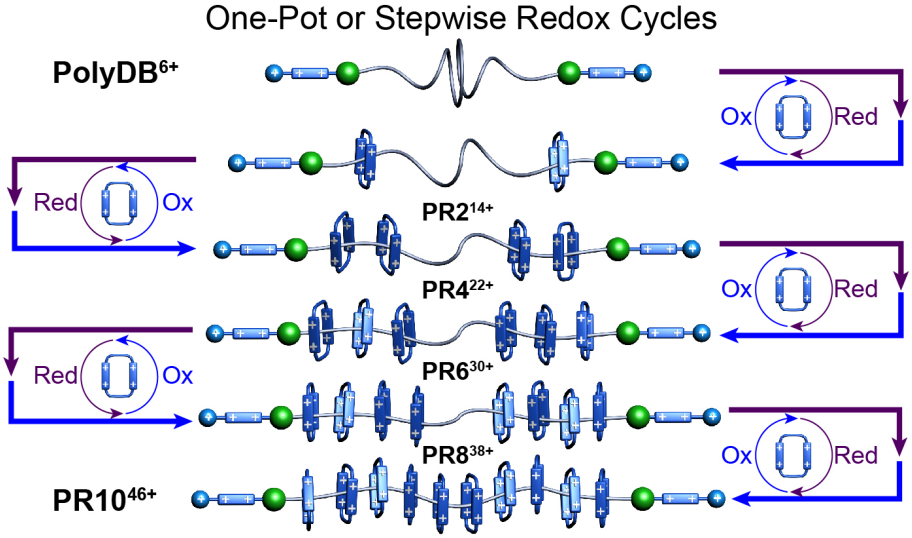

Figure 1. The precision synthesis of polyrotaxanes using artificial molecular pumps with a complete control over the number of threaded rings

References

[1] Qiu, Y.; Song, B.; Pezzato, C.; Shen, D.; Liu, W.; Zhang, L.; Feng, Y.; Guo, Q.-H.; Cai, K.; Li, W.; Chen, H.; Nguyen, M. T.; Shi, Y.; Cheng, C.; Astumian, R. D.; Li, X.; Stoddart, J. F. *Science* **2020**, *368*, 1247–1253.