Polymer Chemistry

ROYAL SOCIETY OF CHEMISTRY

EDITORIAL

View Article Online
View Journal | View Issue

Cite this: *Polym. Chem.*, 2025, **16**, 233

DOI: 10.1039/d4py90151g

rsc.li/polymers

Introduction to trends in thermoresponsive polymers: from chemistry to applications

Theoni K. Georgiou, [a] Richard Hoogenboom [b] and Akihiko Kikuchi [c]

Thermoresponsive polymers are an intriguing class of stimuli-responsive materials that, as the name suggests, respond to temperature. This property enables them to be used in many applications ranging from bioapplications, like drug delivery and tissue engineering, to sensing applications. This themed collection on thermoresponsive polymers covers a wide range of publications. Two reviews aim to summarize the importance of the block sequence on the thermoresponsive properties (**https://doi.org/10.1039/D2PY01097F** and **https://doi.org/10.1039/D2PY01597H**) that has proven to be a significant parameter/factor that can be used to tailor the polymers' self-assembly as well as their thermoresponsive property. Most of the publications focus on thermoresponsive polymers in aqueous solutions while Becer's group also reviews the thermoresponsiveness in non-aqueous solutions (**https://doi.org/10.1039/D2PY01147F**) and Terashima's and Wanless' groups report the salt effect (**https://doi.org/10.1039/D3PY00013C**) and the cosolvent effect (**https://doi.org/10.1039/D2PY01487D**) on the thermoresponsive properties of the polymer solutions, respectively.

A number of polymerisation techniques have been applied for the synthesis of thermoresponsive polymers, including group-transfer polymerisation (**https://doi.org/10.1039/D3PY01032E**), and various radical-based polymerisation methods (**https://doi.org/10.1039/D2PY01518H**, **https://doi.org/10.1039/D2PY00876A**, **https://doi.org/10.1039/D3PY00248A**, **https://doi.org/10.1039/D3PY00287J** and **https://doi.org/10.1039/D3PY00353A**), as well as the combination of group-transfer polymerisation and ring-opening polymerisation (**https://doi.org/10.1039/D3PY00195D**).

Important parameters that are reported to affect the polymer solution phase-transition temperature include deuteration (**https://doi.org/10.1039/D2PY01511K**), architecture/topology (**https://doi.org/10.1039/D2PY01574A** and **https://doi.org/10.1039/D2PY01518H**), side-chain space (**https://doi.org/10.1039/D3PY00154G**), amino-group modification (**https://doi.org/10.1039/D2PY01611G**), counterions (**https://doi.org/10.1039/D2PY01477G**), stereochemistry (**https://doi.org/10.1039/D2PY01528E**) and crowding (confinement) effects (**https://doi.org/10.1039/D2PY00957A**).

Some studies reported dual-responsive polymers where the thermoresponsive component was combined with another component with a photo- or pH-responsive component (**https://doi.org/10.1039/D3PY00248A**, **https://doi.org/10.1039/D3PY00050H**, **https://doi.org/10.1039/D2PY01611G** and **https://doi.org/10.1039/D2PY01044E**). Applications explored in this collection of studies include drug delivery (**https://doi.org/10.1039/D3PY00050H**), wastewater remediation (**https://doi.org/10.1039/D3PY00248A**), DNA enzyme activity enhancement (**https://doi.org/10.1039/D3PY00923H**), emulsion stabilisation (**https://doi.org/10.1039/D2PY00876A**) and encryption/decryption (**https://doi.org/10.1039/D2PY01044E**).

Finally, an interesting report by Hiruta's group also provides an insight on how materials informatics can be used to predict the phase-transition temperature (**https://doi.org/10.1039/D3PY00314K**).

In summary, this themed collection demonstrates the tailorability and broad range of properties and applications that can be explored with the use of thermoresponsive component(s) on the polymeric material. Scientists continue to investigate how different parameters, either structural or environmental, affect the polymer phase-transition temperature and how these can be explored in the material design for a variety of applications. Altogether, we are confident that this collection provides an insight into the current state-of-the-art in the area of thermoresponsive polymers and we hope it serves as an inspiration for future research in the area.

[a]*Department of Materials, Royal School of Mines, Imperial College London, London SW7 2AZ, UK*
[b]*Supramolecular Chemistry Group, Centre of Macromolecular Chemistry (CMaC), Department of Organic and Macromolecular Chemistry, Ghent University, Krijgslaan 281 S4, B-9000 Ghent, Belgium*
[c]*Department of Materials Science and Technology, Faculty of Advanced Engineering, Tokyo University of Science, 6-3-1 Niijuku, Katsushika, Tokyo 125-8585, Japan*

Theoni K. Georgiou

Richard Hoogenboom

Akihiko Kikuchi