Baroplastics: Pressure-Resnponsive Block Copolymers as Sustainable Plastics

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Pressure is one of the state quantities that determines the thermodynamic state of a system but is often treated as a constant, implicitly fixed at 0.1 MPa. Unlike temperature, pressure propagates instantaneously and uniformly throughout a system, making pressure-responsive systems dynamic, manageable, and scalable. In addition, generating and maintaining high pressures equivalent to deep-sea hydrostatic pressures does not require much energy. Thus, materials that respond to deep-sea high pressures could be useful for developing sustainable solutions, such as for materials processing with reduced energy consumption and CO_2 emissions [1].

Baroplastic diblock copolymers exhibit order–disorder transitions (ODTs) and melt upon compression, in some cases even at ambient temperatures (**Figure 1**). The baroplastic behavior is typically observed in block copolymers consisting of a rubbery and a glassy segment. The compressibility mismatch between the two segments plays a critical role in the emergence of the pressure-responsive ODT. We are exploiting the properties of baroplastics to develop sustainable polymers. In this talk, the molecular mechanism of pressure-induced phase transitions and on-demand polymer degradation by pressure will be presented [2].

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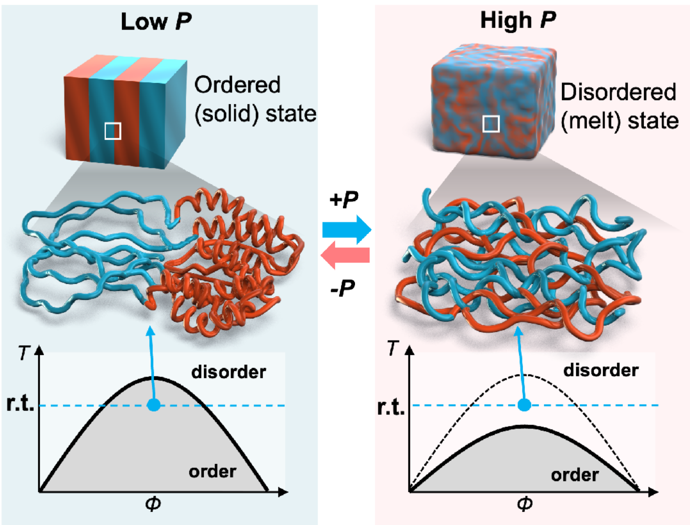

Figure 1. Schematic of pressure-induced ODT of baroplastic block copolymers. Reproduced with permission from ref [1].

References

[1] S. Deguchi *et al.*, *Langmuir* **39**, 7987–7994 (2023).

[2] H. Degaki *et al.*, *Soft Matter* **20**, 3728–3731 (2024).

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