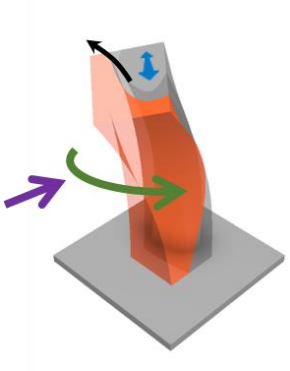
Towards Feedback-Regulated Soft Materials



When designing synthetic materials capable of autonomous and sophisticated responses, incorporation of feedback may seem like an obvious choice. Such feedback loops may couple sensor, actuator, and memory elements of the material system[1] and may provide for homeostatic behaviors or sometimes even more complex (interactive) responses.[2] Yet, designing feedback is surprisingly hard, particularly at the chemical level: beyond what one can learn from metabolic networks and their network motifs, creating feedback-controlled systems is often a result of serendipity. In this talk, I will present our recent work on light-responsive hydrogels[3] and liquid crystalline elastomers[4] and discuss interesting features of these materials and potential avenues for incorporating feedback. For the liquid crystalline elastomer case in particular, opto-chemo-mechanical feedback can be designed for, which can be used to program characteristic power stroke-type beating patterns in microposts. Interestingly, in both material systems the underlying materials are surprisingly simple, yet dynamics highly complex, which raises fundamental questions about how we think about rationally designing complex responses and ultimately feedback in soft materials.

[1] C. Kaspar, B. J. Ravoo, W. G. van der Wiel, S. V Wegner, W. H. P. Pernice, *Nature* **2021**, *594*, 345.

[2] M. M. Lerch, A. Grinthal, J. Aizenberg, *Adv. Mater.* **2020**, 1905554.

[3] A. Meeks, M. M. Lerch, T. B. H. Schroeder, A. Shastri, J. Aizenberg, *J. Am. Chem. Soc.* **2022**, *144*, 219.

[4] S. Li, M. M. Lerch, J. T. Waters, B. Deng, R. S. Martens, Y. Yao, D. Y. Kim, K. Bertoldi, A. Grinthal, A. C. Balazs, J. Aizenberg, *Nature* **2022**, *605*, 76.

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