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Photo-induced locomotion of chemo-responsive polymer gels
PRATYUSH DAYAL, OLGA KUKSENOK, ANNA C. BALAZS, University of Pittsburgh — The need to translate chemical energy into a mechanical response, a characteristic of many biological processes, has motivated the study of stimuli-responsive polymer gels. Recently, it has been shown experimentally that by coupling the mechanical properties of the gel with the Belousov-Zhabotinsky (BZ) reaction it is possible to induce self-sustained oscillations in the gel. One of the means for controlling these chemical oscillations is using light as an external stimulus. To study the effect of light on the mechanical behavior of the gel, we use our recently developed a 3D gel lattice spring model (gLSM) which couples the BZ reaction kinetics to the gel dynamics. In this model, the polymer-solvent interactions were taken into account by adding a coupling term to the Flory-Huggins free energy. By virtue of this coupling term, the swelling—de-swelling behavior of the gel was captured in 3D. In order to include the effect of the polymer on the reaction kinetics, the Oregonator model for the photo-sensitive BZ reaction was also modified. Using gLSM model, we probed the effect of non-uniform light irradiation on the gel dynamics. We were able to manipulate the direction and velocity of locomotion of the gel using light as a control parameter. This ability to control the movement of the gel can be utilized in a variety of applications, ranging from bio-actuators to controlled drug release systems.

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