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Controlling bending of chemo-responsive gels with gradient in cross-link density OLGA KUKSENOK, VICTOR V. YASHIN, ANNA C. BALAZS, University of Pittsburgh — Chemo-responsive gels undergoing the Belousov-Zhabotinsky (BZ) reaction exhibit self-sustained pulsations, which can be harnessed to perform mechanical work. To utilize such BZ gels in a number of technological applications, it is critical to develop a robust approach for controlling their bending and stretching. Using our recently developed gel lattice spring model, we focus on the three-dimensional dynamics of chemo-responsive gels that encompass gradients in their cross-link density. Specifically, we simulate the dynamics of long thin rectangular filaments with a gradient in the cross-link density perpendicular to the long axis. We show that the shape of the sample strongly depends on the physical properties of the gel and the parameters of the BZ reaction. We compare our simulation results on the amplitude of bending with experimental data obtained in Ryo Yoshida's group at the University of Tokyo. We also simulate the dynamics of BZ gels that contain a helical distribution of the gradient in cross-link density and show that such samples form "springs" that exhibit complex motion. Finally, we investigate how bending and spring-like motion of the sample is affected when the sample is attached with one of its ends to a substrate (thus forming an autonomously oscillating cilium). Our studies constitute the first simulation studies of the dynamics of three-dimensional heterogeneous chemo-responsive gels.

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