

Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

Harnessing self-oscillating polymer gels to design active ciliated surfaces PRATYUSH DAYAL, AMITABH BHATTACHARYA, OLGA KUKSENOK, ANNA C. BALAZS, University of Pittsburgh — Via theory and simulations, we design active surfaces capable of replicating characteristics of biological cilia. Our approach harnesses the use of polymer gels that undergo photosensitive Belousov-Zhabotinsky (BZ) reaction. Powered by internalized BZ reaction these polymer gels swell and de-swell autonomously due to the chemo-mechanical transduction and therefore are ideal materials for designing our system. We have successfully developed an efficient hybrid approach by combining our three dimensional gel lattice spring model (3D-gLSM) and Lattice Boltzmann Method (LBM) which allows us to capture the interactions between the cilia and the surrounding fluid. Using our gLSM-LBM hybrid model we determine the factors that govern the bending and beating of individual cilium and also their collective dynamic behavior. Our findings provide guidelines for designing ciliated surfaces that can exhibit biomimetic functionality.

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Date submitted: 19 Nov 2010

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