Bulletin of the American Physical Society

APS March Meeting 2023
Las Vegas, Nevada (March 5-10)
Virtual (March 20-22); Time Zone: Pacific Time

Session M11: Biological Active Matter III
8:00 AM–11:00 AM, Wednesday, March 8, 2023
Room: Room 203

Sponsoring Unit: DBIO

Abstract: M11.00008 : Competition of convection and diffusion in the self-mixing of microtubule-kinesin active fluid with non-uniform activity: Experiment*

9:48 AM–10:00 AM

← *Abstract* →

Presenter:
Teagan Bate
(Worcester Polytechnic Institute)

Authors:
Teagan Bate
(Worcester Polytechnic Institute)

Megan Varney
(Worcester Polytechnic Institute)

Ezra Taylor
(Worcester Polytechnic Institute)

Joshua Dickie
(Worcester Polytechnic Institute)

Chih-Che Chueh
(National Cheng Kung University)

Michael M Norton
(Rochester Institute of Technology)

Kun-Ta Wu
(Worcester Polytechnic Institute)

Active fluids have potential applications in micromixing, but little is known about the mixing kinematics of such systems with spatiotemporally-varying activity. To investigate, UV-activated caged ATP was used to activate controlled regions of microtubule-kinesin active fluid inducing a propagating active-passive interface. The mixing process of the system from non-uniform to uniform activity as the interface advanced was observed with fluorescent tracers and molecular dyes. At low Péclet numbers (diffusive transport), the active-inactive interface progressed toward the inactive area in a diffusion-like manner and at high Péclet numbers (convective transport), the active-inactive interface progressed in a superdiffusion-like manner. The results show mixing in non-uniform active fluid systems evolve from a complex interplay between the spatial distribution of ATP and its active transport. This active transport may be diffusion-like or superdiffusion-like depending on Péclet number and couples the spatiotemporal distribution of ATP and the subsequent localized active stresses of active fluid. Our work will inform the design of future microfluidic mixing applications and provide insight into intracellular mixing processes.

*T.E.B., E.H.T., J.H.D., and K.-T.W. acknowledge support from the National Science Foundation (NSF-CBET-2045621). C.-C. C. was supported through the National Science and Technology Council (NSTC), Taiwan (111-2221-E-006-102-MY3). M.M.N. was supported by the U.S. Department of Energy, Office of Science, Office of Basic Energy Sciences (DE-SC0022280).