World Academy of Science, Engineering and Technology
International Journal of Chemical and Molecular Engineering
Vol:17, No:04, 2023

Controlling Interactions and Non-Equilibrium Steady State in Spinning Active Matter Monolayers

Authors : Joshua Paul Steimel, Michael Pappas, Ethan Hall

Abstract : Particle-particle interactions are critical in determining the state of an active matter system. Unique and ubiquitous non-equilibrium behavior like swarming, vortexing, spiraling, and much more is governed by interactions between active units or particles. In hybrid active-passive matter systems, the attraction between spinning active units in a 2D monolayer of passive particles is controlled by the mechanical behavior of the passive monolayer. We demonstrate here that the range and dynamics of this attraction can be controlled by changing the composition of the passive monolayer by adding dopant passive particles. These dopant passive particles effectively pin the movement of dislocation motion in the passive media and reduce the probability of defect motion required to erode the bridge of passive particles between active spinners, thus reducing the range of attraction. Additionally, by adding an out of plane component to the magnetic moment and creating a top-like motion a short range repulsion emerges between the top-like particle. At inter-top distances less than four particle diameters apart, the tops repel but beyond that, distance attract up to 13 particle diameters apart. The tops were also able to locally and transiently anneal the passive monolayer. Thus we demonstrate that by tuning several parameters of the hybrid active matter system, one can observe very different emergent behavior.

Keywords : active matter, colloids, ferromagnetic, annealing
Conference Title : ICCSMM 2023 : International Conference on Chemistry of Soft Matter Materials
Conference Location : Boston, United States
Conference Dates : April 17-18, 2023

Open Science Index, Chemical and Molecular Engineering Vol:17, No:04, 2023 publications.waset.org/abstracts/155350.pdf