Seminar/Talk

Soft and adaptive active systems: towards cell-mimetic microdevices

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Bioinspired microdevices are the prelude to a great advance in biomedical technologies. However, there is a clear gap in fabricating prototypes of the size and complexity of cells [1]. Active colloids are an experimental paradigm to realize microrobots due to their ability to self-propel and perform simple tasks [2, 3], yet they fail to provide autonomous units due to their limited geometries and materials, and lack of autonomy. How can we push the experimental limits and realize bioinspired microscale devices?Here, I will demonstrate that using soft and adaptive building blocks is the key to a new generation of biomimetic active colloids. In particular, I will show our recent results on the fabrication of cell-like active assemblies using giant unilamellar vesicles (GUVs) under external actuation [4]. In contrast to the traditional active colloids, active GUVs present an excellent cell-model system, thanks to their membrane permeability and ability to enclose nano and micro-objects. We report on their run-and-tumble dynamics, reminiscent of bacteria dynamic patterns. We further explore their ability to deform and divided when applying external fields. The proposed cell-like architecture reveals exciting opportunities for the development of soft and adaptive active microdevices with in-built feedback via bottom-up approaches.Fig 1. Fluorescence microscopy picture of phase-separated active Janus vesicle driven by AC electric field. The motion of the vesicle undergoes runs and tumbles, due to the transient mixing of the lipid domains.[1] Nelson BJ, Kaliakatsos IK, Abbott JJ. Microrobots for minimally invasive medicine. Annu. Rev. Biomed. Eng. 15, 55 (2010)[2] Alvarez, L.*, Fernandez-Rodriguez M.A., Alegria A., Zhao, K., Kruger, M., Isa, L.*, Reconfigurable Artificial Microswimmers with Internal Feedback. Nature Communications, 12, 4762 (2021)[3] van Kesteren, S., Alvarez, L., Arrese-Igor, S., Alegría, A., Isa, L*, Self-propelling colloidal finite state machines. PNAS, 120, e2213481120 (2023)[4] Willems, V., Baron A., Matoz-Fernandez, D., Wolisfberg, G., Dufresne, E., Alvarez, L*. Phase-separation dependent active motion of Janus Vesicles. ArXiv (under review, 2023)

Tuesday, April 9, 2024 11:00am - 12:00pm

Sunstone Bldg / Ground floor / Big Seminar Room B / 63 seats (I23.EG.102)

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