International Conference on Mathematical Modeling and Applications (ICMMA)
"Spatio-temporal patterns on various levels of the hierarchy of life"

pH Triggered Self-Division of Giant Vesicles Driven by an Internal Enzymatic Reaction

István Lagzi

Department of Physics, Budapest University of Technology and Economics, H-1111 Budafoki ut 8, Budapest, Hungary

MTA-BME Condensed Matter Research Group, Budapest University of Technology and Economics, H-1111 Budafoki ut 8, Budapest, Hungary

e-mail: istvanlagzi@gmail.com

In this presentation, we will show that an artificial cell (giant unilamellar vesicle, GUV) can undergo self-division triggered by an autonomous internal chemical stimulus (Figure 1). The experimental system we envisaged, built with a bottom-up strategy, takes into account all the basic features required to copy the biological processes at the base of living cells duplication [1], namely: *(i)* **an active interplay between the vesicle membrane and the chemical network** present inside the vesicle lumen; in our case the vesicle chassis is made by a mixture of phospholipids and fatty acids, whilst the chemical network is an enzymatic reaction (urea-urease); *(ii)* **a selective trans-membrane communication** between the outside environment and the vesicle lumen; here the substrate (urea) for the enzymatic reaction is delivered in the outer solution and, upon crossing the membrane, activate in vitro a chemical reaction that leads to a structural instability; (iii) **an internal trigger driving the division process**; a pH jump following the enzymatic reaction change the protonation degree of fatty acids in the membrane of GUVs and, in turn, the relative surface area between the inner and the outer membrane leaflet. In the context of the existing literature, our synthetic minimal cells are the simplest system to show such a complex behavior; they can actually be considered as a model for primitive cells (protocells) and be employed to unveil the basic mechanisms that drove the transition from inanimate to animate matter. Moreover, with respect to previous attempts, we also demonstrated that physical inputs (temperature, mass transfer, stirring) are unnecessary. We believe that our study provide a next step towards understanding the origin of life.

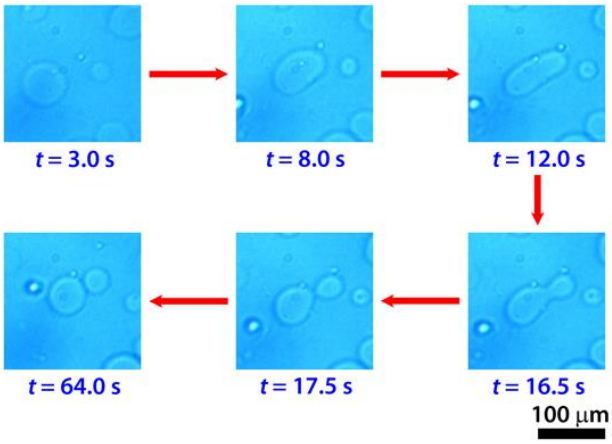

Figure 1. Self-division of giant vesicles driven by an internal enzymatic reaction.

Reference

[1] Z. Medveczky, Y. Miele, G. Holló, B. Tegze, I. Derényi, Z. Hórvölgyi, I. Lagzi, F. Rossi, Self-

International Conference on Mathematical Modeling and Applications (ICMMA)
"Spatio-temporal patterns on various levels of the hierarchy of life"

Division of Giant Vesicles Driven by an Internal Enzymatic Reaction (submitted).