Autonomous Arrangement of Micro-Droplets Entrapping DNA and Living Cells Generated through Micro Phase-Separation

([1]*Department of Chemical Engineering and Materials Science, Doshisha University*, [2]*Faculty of Life and Medical Sciences, Doshisha University*) ○Mayu Shono,[1] Ritsuki Ito,[2] Fumika Fujita,[2] Hiroki Sakuta,[2] Akihisa Shioi,[1] Kenichi Yoshikawa[2]

Keywords: Water/Water Micro Phase-Separation; Proto Cell; Spontaneous Arrangement of Droplets

Cell-sized micro-droplets are focused on as a proto cell with a polymer-crowded environment like living cells. These droplets can be generated through the water/water micro phase-separation of a binary polymer solution (PEG/DEX). Recently, a proto cell structure that can be created by utilizing these micro-droplets has attracted great interest.[1, 2]

Figure 1 shows linear arrangement of the micro-droplets generated in an autonomous manner along a glass capillary (inner diameter: 140 μm), which was generated from an aqueous solution of PEG/DEX. It is noted that these droplets are entrapping DNA and living cells spontaneously. Dashed lines indicate the inner glass wall. Figure 2 (right panel) shows snapshots of the micro-droplets arranged by introducing PEG/DEX aqueous solution, where the green region corresponds to DEX-rich solution. The spatio-temporal plot on the left panel shows the generated droplets are linearly arranged with almost the same size and stable over 30 min, at least. Time indicates the duration after the start of the microscopic observation, which is 2 min after the timing of mechanical mixing. The mechanism of our novel observations will be discussed with the help of theoretical analysis by using Cahn-Hilliard-type partial differential equation.

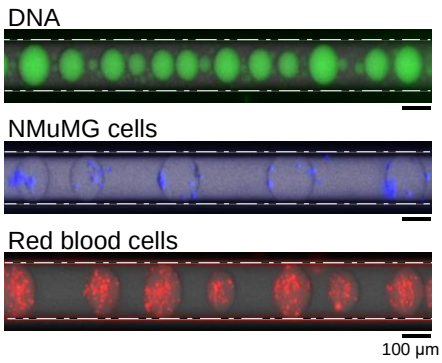

Fig. 1 Linearly arranged w/w droplets entrapping DNA and living cells in a self-organized manner.[3] Dashed lines indicate the inner glass wall.

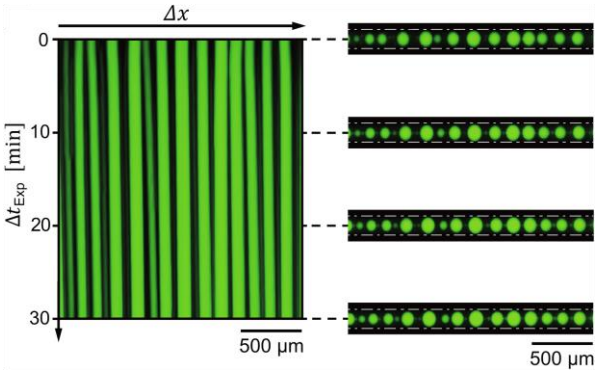

Fig. 2 Stability of the arranged droplets. Left: Spatio-temporal plot, Right: Snapshots of the capillary at different times.[3] Δt_{EXP} is the time that starts at 2 min after the mechanical mixing.

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