Is Research on “Synthetic Cells” Moving to the Next Level?

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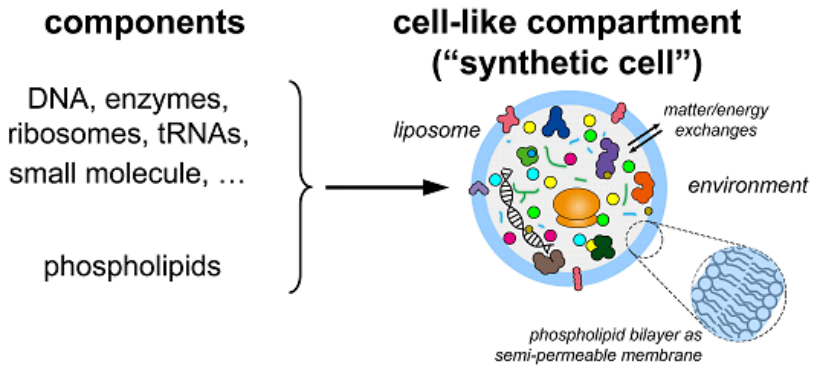
Synthesizing proteins inside liposomes and other microcompartments is a well-established practice. However, the origin of this research is not from the distant past, dating back to 1999‑2004, when the first successful attempts were published. Protein synthesis and other reactions inside artificial compartments are approaches that lead to the construction of “synthetic cells” [1,2,3], a hot topic in bottom-up synthetic biology (Figure 1). The entire field ultimately relies on the convergence between chemistry, biochemistry and the chemistry and physics of artificial micro-compartments in the “colloidal domain”. Being biomimetic structures, synthetic cells can contribute to a deeper understanding of the biological organization and moreover they can be designed for very innovative uses in biotechnology. Here we summarize some technical and theoretical aspects of synthetic cell research, mainly based on gene expression and other enzymatic reactions inside liposomes, and in particular we will comment on the most recent trends. Such a tour will be an occasion for asking whether times are ripe for a sort of qualitative jump toward novel SC prototypes: is research on “synthetic cells” moving to a next level?



Components	Examples
Primitive-like	Fatty acids, isoprenoids, ribozymes, short peptides, …
Biological	DNA, ribosomes, enzymes, tRNAs, phospholipids, …
Artificial	Polymers, surfactants, PNAs, inorganic catalysts, …

Figure 1. Synthetic cells are made by encapsulating (bio)chemicals inside artificial compartments (Reproduced from: Stano, MDPI Life **9** (2019) 3).

[1] Rampioni, G.; D'Angelo, F.; Messina, M.; Zennaro, A.; Tofani, D.; Kuruma, Y.; Leoni, L.; Stano, P. Synthetic cells produce a quorum sensing chemical signal perceived by Pseudomonas aeruginosa. *Chemical Communications* 2018, *54*, 2090-2093.

[2] P. Stano. Is research on "synthetic cells" moving to the next level? *MDPI Life* 2019, *9*, 3.

[3] P. Stano. Gene expression inside liposomes: from early studies to current protocols. *Chemistry - A European Journal* 2019, *25*, 7798-7814