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Harnessing cells with external nanocompartments expands their metabolic repertoire

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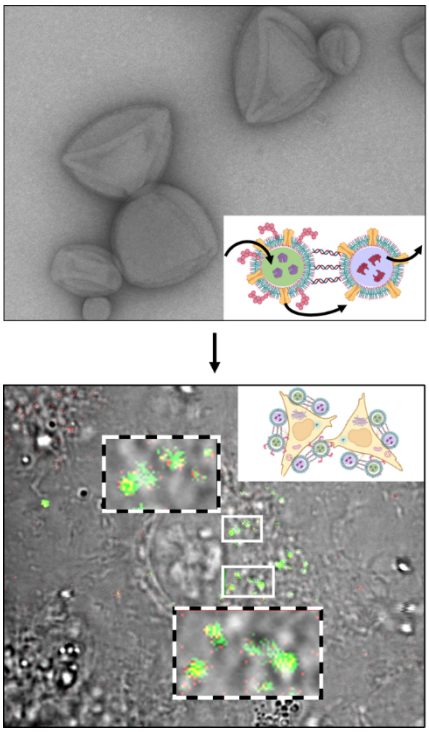
In nature, compartmentalization is essential to control the communication inside cells and between them in order to support their metabolism. Taking inspiration from natural small compartments named organelles that are present inside cells, NCCR Molecular Systems Engineering researchers at the University of Basel developed a variety of synthetic compartments loaded with enzymes. These compartments are able to support complex reactions and mimic the communication between natural organelles aiming to expand the potential of cells. The results have been published in the journal *Chemical Science*.



A team led by Prof. Cornelia Palivan from the Department of Chemistry at the University of Basel reported a novel manner to combine nanocompartments loaded with enzymes to allow cascade reactions between them. These enzyme-loaded compartments were bound together by using DNA as linkers and successfully promoted 3-steps reactions between them with unprecedented control.

"Artificial organelles" endow cells with an exogenous metabolic pathway

The DNA on the nanocompartment surface was not only a way to form clusters. The researchers also found that it allowed the clusters to accumulate on the outer surface of human cells, binding to a class of proteins called scavenger receptors, without entering the cells. This behaviour resulted in a robust decoration of cell membranes with complex "artificial organelles", which endowed cells with an exogenous metabolic pathway that opens a new strategy for cell-localized, multi-enzyme reactions. As a proof of concept, the team harnessed cells with a cascade reaction that converted amylose, a component of starch, to a fluorescent compound, a completely novel pathway that does not exist in human cells.

The first author of the study, Dr. Viviana Maffeis, commented: "This is not the first time that artificial organelles have been added to a cell, but never could they achieve such a tight control on such a complex system. Even more interestingly, our group is the first to target artificial organelles to the outer surface of cells, rather than to their cytoplasm, opening up a completely new set of transformations in the immediate microenvironment. Last but not least, the design is completely modular and allows to easily mix different enzymes for different purposes."

“Cell-associated nanoreactor clusters open new avenues for highly efficient applications in domains such as catalysis or nanomedicine, as cells can be easily and reliably made capable of performing new biotransformations” adds Prof. Palivan.

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Reference

Viviana Maffeis, Andrea Belluati, Ioana Craciun, Dalin Wu, Samantha Novak, Cora-Ann Schoenenberger and Cornelia G. Palivan “Clustering of catalytic nanocompartments for enhancing an extracellular non-native cascade reaction” *Chem. Sci.* **2021**, https://doi.org/10.1039/D1SC04267J

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Links

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