CHRISTMAS LECTURE

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Repurposing cell metabolism to assemble cell-free biofactories

Assembling isolated enzymes, either in their pure or crude formulation, into biosynthetic pathways of certain complexity has given rise to a new discipline; cell-free synthetic biology also coined as synthetic biochemistry or systems biocatalysis. Most existing examples are limited to free enzymes, leading to systems with low robustness that are difficult to transfer across different reactor configurations for further intensification. The rational co-immobilization of multi-enzyme systems on solid porous materials is opening a new avenue to intensify and scale up both natural and artificial biosynthetic pathways. Yet, their implementation in flow reactors for their continuous operation is scarce

Inspired by spatial organization and molecular confinement within living cells, our group has exploited immobilization techniques to spatially arrange various multi-enzyme systems (including oxidoreductases, oxidases, and transaminases) alongside their required cofactors (such as NAD(P)H, PLP, and FAD) on synthetic porous carriers. Our objective is to develop self-sufficient, multi-functional heterogeneous biocatalysts capable of recycling and reutilizing cofactors and enzymes in different reactor configurations across multiple operational cycles.

In this lecture, the advantages of co-immobilizing enzymes and cofactors will be discussed, as well as their associated limitations. Thoroughly exploiting synergies in biocatalytic cascade reactions, new artificial multi-enzyme cascades can open new paths to upgrade monofunctional molecules into multifunctional ones of higher-added value. Furthermore, we envision energetically more favorable pathways that in situ recycle cofactors, installing self-sustaining steps that do not require ancillary substrates and energy inputs, thus improving the atom economy and the energetic balance of the cell-free bioprocesses.

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12.00 H

Gipuzkoa Science and Technology Park,
Mikeletegi 53 (Edificio Central, Auditorium)

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