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CIC biomaGUNE
CENTER FOR COOPERATIVE RESEARCH IN BIOMATERIALS

seminar

Monday, 25th March, 12.00 pm, Seminar Room

Host: Fernando López-Gallego

Design and engineering of artificial metabolic cells for chemical manufacturing

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Industrial biocatalysis is a smart path towards more cost-effective and sustainable chemical processes. However, there are still some drawbacks in terms of enzyme stability, molecule recycling and mass transfer matters among others that limit the progress of heterogeneous biocatalysis. In order to overcome these issues, micro-scale approaches and rational designs of heterogeneous biocatalysts are needed to make more efficient the final industrial reactions. Inspired by the natural compartmentalization of metabolic pathways inside the living cells, we assembled molecular systems into artificial solid supports to build a functional biomaterial called artificial metabolic cell. Based on this concept, different micro-architectures were developed for the co-immobilization of multi-enzyme systems and the expensive cofactors on solid materials. The integration of all molecules in the solid phase enabled the recycle and reuse of the heterogeneous biocatalysts, decreasing costs and waste. The scope of this strategy was expanded to engineer artificial metabolic cells based on different enzymes (dehydrogenases, oxidades, ketoreductases and w-transaminases) with their corresponding cofactors (NADH, FAD+, NADPH and PLP). Parallely, we developed several techniques to aid and guide the design process of these heterogeneous biocatalysts. Firstly, a synthetic-biological platform was developed to easily screen different materials and binding chemistries for the protein immobilization. Secondly, fluorescence microscopy was applied to analyze the distribution of enzymes and cofactors onto the porous microparticles at single-particle level and with spatio-temporal resolution. Finally, artificial metabolic cells were successfully tested in continuous flow reactions for the asymmetric synthesis of several chiral amines and alcohols.