ENGINEERING BIOCATALYTIC NANOREACTORS

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Cellular compartmentalization enables enzymes to perform complex sequences of chemical transformations with high efficiency and exquisite enantio, regio and chemo-selectivity under mild conditions. Reproducing such performance of individual biocatalysts, as well as entire enzyme cascades at the bench and in industry offers tremendous opportunities for future developments of green and sustainable chemical processes. Native, protein-based nanocompartments from bacteria represent very robust carrier matrices for the assembly of artificial biocatalytic nanoreactors, yet suffer from ineffective permeability of metabolites and small molecules due to small pores in the protein shell and non-existence of exterior surface functionality. Addressing these shortfalls through protein engineering enables the creation of tailored carriers that have the potential to serve as highly versatile scaffold with excellent control over spatial organization of (bio)catalysts. Such immobilization benefits enzyme stability and catalyst recovery but also promises additional functional gains by substrate channeling between proximal active sites.

Figure 1 – Engineered encapsulins as nano-scale architectures for biocatalysis