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Xenobiotic responses and synthetic biology

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Xenobiotic receptor pregnane X receptor (PXR) is a promiscuous nuclear receptor that functions as a sensor to a wide variety of xenobiotics to regulate the expression of drug metabolizing enzymes and transporters. Xenobiotics that are known to activate PXR and trigger xenobiotic responses include synthetic chemicals and synthetic peptides. Since activation of PXR might lead to clinical drug-drug interaction, it is critical to investigate the xenobiotic responses and design strategy to minimize the undesired impact of synthetic materials on drug metabolism. By using a chemical biology approach we have developed modulators of PXR that will be useful for modulating xenobiotic responses triggered by synthetic materials.

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Towards a bionic cell: Coupling compartmentalized synthetic vesicles with biological machinery and living components

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Vesicle-based artificial cells are considered by many as the next generation of smart soft-matter devices. These are constructed from the bottom-up using a combination of synthetic and biological components to yield engineered synthetic cells with bespoke functionality. We have pioneered a new breed of artificial cells based on multi-compartment vesicles that are generated using droplet-based microfluidics. By transplanting cellular machinery into these vesicles we show that each compartment can be treated as a distinct module devoted to specific biological tasks. We have engineered communication routes between these modules via protein pores and enzymatic signaling cascades and use this for both small-molecule and protein synthesis within the vesicle. We can now also encapsulate whole cells within vesicles and can demonstrate that the vesicle 'host' and the cellular 'organelle' enjoy a symbiotic relationship. The resulting artificial eukaryote can thus be considered a novel living/synthetic hybrid material.

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