Organocatalytic control over a fuel-driven esterification network

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Signal transduction in living systems is the conversion of information into a chemical change and the principal process by which cells communicate over micrometre distances. This enables phenomena, such as time-keeping and signal-amplification. In nature, these functions are encoded in far-from-equilibrium biochemical reaction networks controlled by enzymes. While these catalytically controlled processes are an integral part of biocatalytic pathways, man-made systems are rare. Therefore, the aim of this research is to incorporate catalysis in a fuel-driven out-of-equilibrium chemical reaction network, as a means to control material properties in time and space. The study entails the design of an organocatalytic controlled fuel-driven esterification network (Fig.A) and a self-assembling system. The forward (ester formation) and backward reaction (ester hydrolysis) are controlled by varying the ratio of two different organocatalysts: pyridine (FIG.B) and imidazole (Fig.C), enabling full control over ester yield and lifetime. Altogether, we will show how organocatalysis is an important tool to exert control over a man-made fuel-driven system, constituting a first step towards signal response in man-made materials.

A. Fuel driven esterification network controlled by organocatalysts pyridine and imidazole. Monitoring the conversion of para nitrophenol. B. Pyridine concentration variation. C. Imidazole concentration variation.

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