Systems biocatalysis for the preparation of monomers

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The monomer units for polyamides are α-amino-carboxylic acids, lactams or diamines and dicarboxylic acids. Caprolactam, for example, is produced chemically from cyclohexanone, which is first converted to its oxime. Treatment of this oxime with acid induces the Beckmann rearrangement to give caprolactam.

Biocatalytic cascades involving redox steps[1] allow to perform oxidation and reduction reaction in the linear sequence simultaneously.[2,3] By design oxidation and reduction reactions might be coupled in that way that the electrons gained in the oxidation step are consumed in the reduction step turning the overall process redox neutral and cost efficient.

Here we report a biocatalytic redox cascade starting from cyclohexanol to yield ω-amino caproic acid, thus the hydrolysed equivalent to caprolactam. The designed cascade involves four redox steps and additional hydrolytic steps, whereby the cascade was designed in that way, that no external redox reagents were required, thus the cascade was redox neutral or redox self-sufficient. Since an intermediate in the reaction sequence caused inhibition for a later enzyme in the cascade an in situ functional group protection strategy was established to avoid the formation of the inhibiting compound.

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