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Title: DNA Hairpins for Asymmetric Catalysis

DNA is not only one of the most important biopolymers, but also an extremely interesting functional polymer for molecular self-assembly. In catalysis, it can be used to assemble so-called “hybrid catalysts”, which are formed from a piece of DNA and a low molecular weight metal complex. These hybrid catalysts can be applied in asymmetric catalysis to promote highly enantioselective reactions such as Diels-Alder reactions. While the application of these hybrid catalysts has been successfully demonstrated, the mechanistic understanding is very limited and structural information on active hybrid catalysts is missing. Recently, the Hennecke group has introduced short oligonucleotides forming hairpin structures as the nucleic acid component of hybrid catalysts (*Chem. Eur. J.* **2017**, *23*, 6004). Due to the short length and the high stability of their secondary structure, these DNA hairpins open new avenues in hybrid catalysis research. In one line of research, it is planned to use these hairpins for structural studies using either NMR or X-ray analysis to characterize a DNA-based hybrid catalyst for the first time at the atomic level. In a second line of research, synthetic chemistry will be used to covalently modify the DNA hairpin structures with catalytically active units such as flavins or dyes to enable the preparation of single component hybrid catalysts with new functions in asymmetric synthesis. This part of the project will require the synthesis of new building blocks for phosphoramidate-based nucleic acids synthesis as well as solid phase synthesis of DNA oligonucelotides. The newly obtained hybrid catalyst will then be evaluated in asymmetric catalysis of sulfoxidations, reductions or carbon-carbon bond forming processes such as Alder-Ene-reactions or Claisen rearrangements. In this area, there is plenty of room for new creative transformation. For more information, contact Prof. Hennecke.

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