Artificial metalloenzymes as catalysts, future drugs, and tools for fundamental science

In the context of environment-friendly green chemistry, enzymes are considered first-class catalysts but their usefulness is hampered by their high-substrate specificity as well as their limited scope of catalysis. To overcome these hurdles artificial metalloenzymes (AMEs) have been developed by incorporating chemical catalysts inside proteins. On the one hand, chemical catalysts bestow AMEs with a wide scope of activity while on the other, protein residues provide a chiral environment and eco-compatibility. AMEs are now considered as a major development addressing the increase in societal and governmental pressure that demand greener chemistry.

The seminar will feature the development of artificial metallo-Diels-Alderases as well as potential applications of such biorthogonal AMEs. We demonstrated that these remain functional in living cells which opens new horizons for applications in therapy and diagnostics.

The chemical and biological components of AMEs can be separately fine-tuned to optimize catalysis. Such chemo-genetic optimizations are a unique feature of AMEs and have led to highly efficient examples. Recently while designing the active site of an AME, we witnessed how the protein fold adapts to different metals and how single mutations distant from the active site can affect metal coordination. Rationalizing the observations made while studying AMEs is proving to be useful to our understanding of metal coordination in metalloproteins in general.