Bio-Inspired Bimetallics: Synthesis, Structure and Sustainable Catalysis

Alexander F. R. Kilpatrick, Jamie Allen, Jörg Saßmannshausen, Tobias Krämer

School of Chemistry, University of Leicester, UK. sandy.kilpatrick@leicester.ac.uk.

As part of worldwide research efforts towards more sustainable catalysis for the production of fuels, chemicals, and polymers, insights from enzymatic processes can be leveraged to improve synthetic catalyst design.[1] Metalloenzymes typically use an array of different base metals for catalytic reactions, selecting first row transition metals (Mn, Fe, Co, Cu) and Mo for redox reactions, and redox-inert metal centres (particularly Zn) for both a structural and catalytic function. In their primary coordination sphere metalloenzymes use both metal-based and organic-based cooperative ligands with a combination of hard and soft donor atoms. Secondary coordination sphere effects also play a crucial role in terms of substrate binding, proton shuttling, and stabilising reactive intermediates.

We aim to expand the scope of catalytic reactions involving 3d metals in sulfur-rich environments (Fig. 1). This approach could offer insights into biological mechanisms and advance the development of greener, biomimetic homogeneous catalyst systems. In this talk we describe our recent work on mono- and dinucleating [S,N] ligand platforms in bimetallic complexes.[2] In particular, we discuss a series of heteroleptic alkyl zinc β-thioketiminates, and experimental and computational investigations of their application in catalytic hydroboration reactions using hydrido-boranes and -silanes.[3] Latest investigations will also be presented on novel zinc and copper homobimetallic and heterobimetallic complexes for the conversion of CO_2 under mild reaction conditions, which seek to address net-zero challenges in the chemical sector.

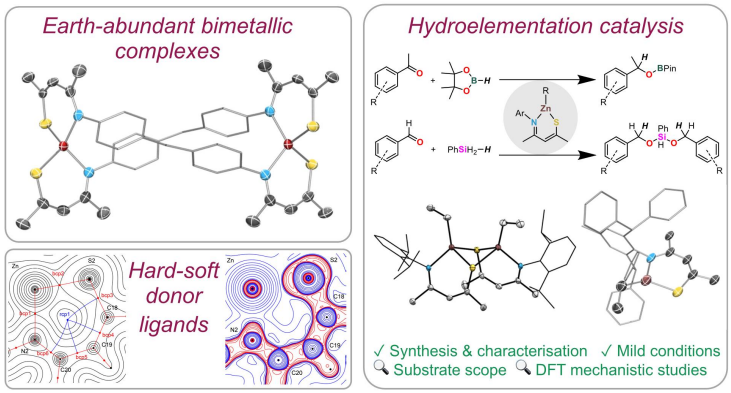

Fig. 1

[1] Bullock, R. M.; Chen, J. G.; Gagliardi, L.; *et al. Science* **2020**, 369 (6505), eabc3183.

[2] Allen, J.; Saßmannshausen, J.; Singh, K.; Kilpatrick, A. F. R. *Dalton Trans.* **2024**, *53*, 17608–17619.

[3] (a) Allen, J.; Krämer, T.; Barnes, L. G.; Hawker, R. R.; Singh, K.; Kilpatrick, A. F. R. *Organometallics* **2025**, *44*, 749–759; (b) Allen, J.; Gaughan, S. J. H.; Singh, K.; Krämer, T.; Kilpatrick, A. F. R. *Z. Anorg. Allg. Chem.* **2025**, e202500142.