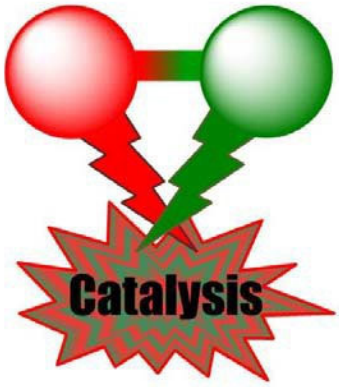
Topics for Bachelor Theses and Advanced Internships AK Hey-Hawkins

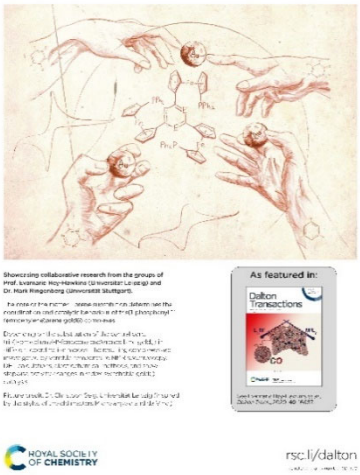
The goal of our interdisciplinary research is the targeted synthesis of molecular compounds for applications in the field of catalysis or medicine or as precursors for new materials.

Selected topics in the field of "Catalysis":

Two Heads are Better than One: Designing Heterobimetallic Complexes for Catalysis



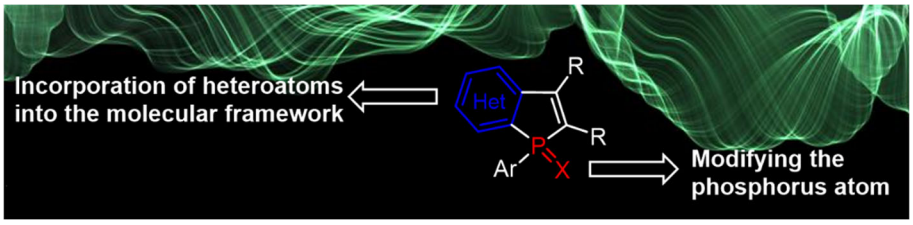
Complexes containing two different catalytically active metal centres can offer exciting chemical and physical properties which can be used in catalysis. The key to designing these “heterobimetallic” complexes is the synthesis of a ligand with distinct coordination sites able to bind suitable metal ions. With such a ligand, and the wide range of metal ions available, the construction of different heterobimetallic complexes is limited only by your imagination! (**Zeno Fickenscher**, Lab 308, Tel. 97-36121; **Reike Clauß/Saral Baweja**, Lab 308, Tel. 97-36121)



Ferrocene-based phosphane ligands

combine several functionalities and are particularly suitable for the targeted synthesis of redox-active transition metal complexes. If functionalised with additional Lewis-binding sites for metals or solubility-mediating groups, exciting ligands are formed that can find application particularly in redox-switchable homogeneous catalysis.

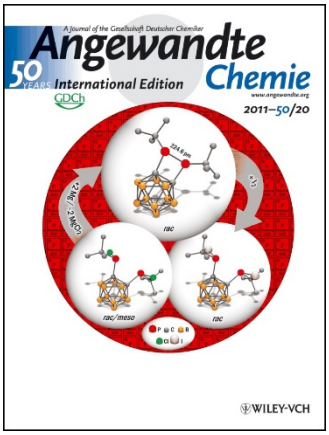
Synthesis of novel phosphole-based *π*-systems



The incorporation of the phosphole motif into *π*-conjugated molecular frameworks and aryl-rich systems has attracted much interest in recent decades. Such compounds show interesting optical properties and a potential use as emitters in OLEDs (organic light emitting diodes) is currently being explored. Due to the unique structure of phospholes, the optical properties of the molecule can be strongly influenced by different chemical modifications of the environment of the phosphorus atom. Therefore, our research is focused on the development of modern synthetic strategies for the design and derivatisation of novel phosphole-based molecular frameworks. (**Nils König**, Lab 313, Tel. 97-36136)

Further selected topics in the field of "Catalysis":

Electron-deficient carboranyl phosphanes as ligands

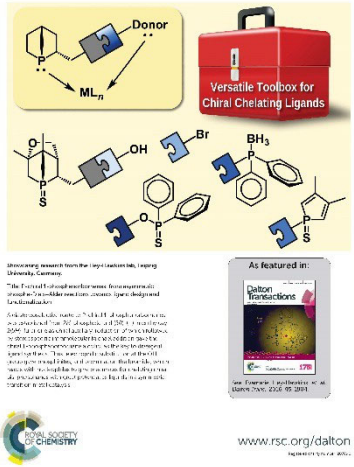


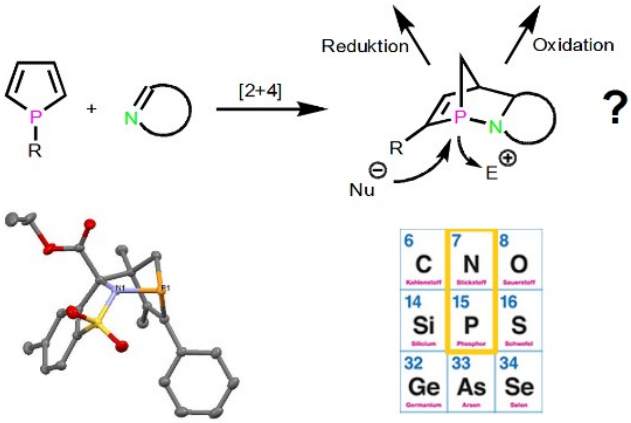
Ortho-carboranes (three-dimensional inorganic benzene analogues) can be modified at the C-H positions by phosphorus-containing groups leading to new types of carboranylphosphanes, -phosphonites, etc. Some of these compounds show unusual reactivity and can be used as electron-poor (chiral) ligands in homogeneous catalysis. (**Max Milewski**, Lab 312, Tel. 97-36134)

Novel P,N Heterocycles

The Hey-Hawkins group was one of the first to synthesise the 1-phospha-2-aza-norbornenes, a new class of compounds that still exhibit many unknown properties. Accessible by a hetero,hetero-DIELS-ALDER reaction, 1-phospha-2-aza-norbornenes can serve as starting materials for many new P,N heterocycles.

The present research focuses on exploiting the reactive phosphorus–nitrogen bond. (**Dr. Peter Wonneberger**, Lab 313, Tel. 97-36136; **Kyzgaldak Ramazanova** Lab 312, Tel. 97-36134)

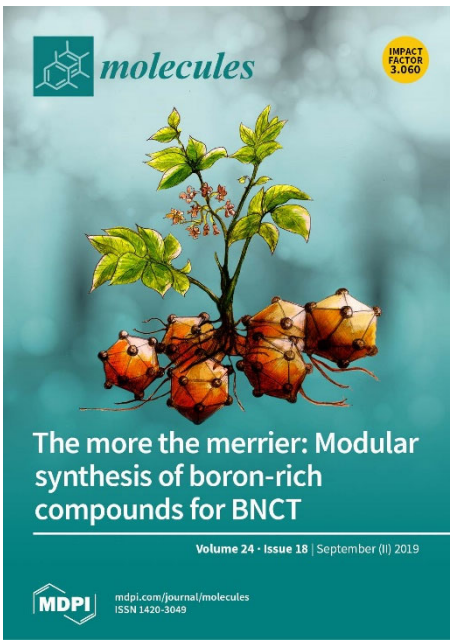


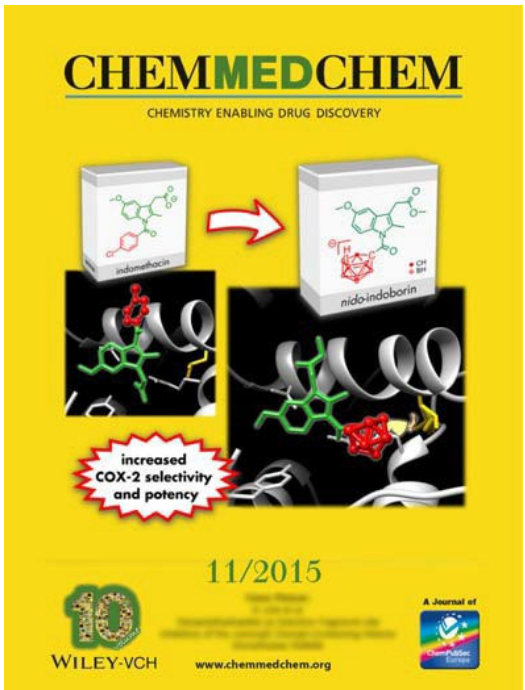


For more information, contact the named Hey-Hawkins group members (3rd floor Inorganic Chemistry) or Prof. Hey-Hawkins (Office 141).

Selected topics in the field of "Inorganic compounds for medical applications":

One approach for the **selective destruction of tumour tissue** in the presence of healthy cells is **boron neutron capture therapy (BNCT)**. Carboranes and their derivatives are particularly suitable as boron sources, since they have a high boron content, low toxicity and very high kinetic stability. In addition, they can be easily integrated into organic and biochemical structures due to their organic reaction behaviour. In this project, boron-rich compounds are developed which will then be coupled to biochemical compounds (Trojan horse strategy) that allow selective tumour targeting. (**Philipp Stockmann**, Lab 312, Tel. 97-36134)





Carboranes as pharmacophores

In addition to their inorganic character and three-dimensional aromaticity, carboranes also exhibit high hydrophobicity - properties that make carboranes particularly interesting for drug development, especially as pharmacophoric residues replacing phenyl residues in biologically active compounds. The targets of interest are in particular enzymes and proteins that, among other things, play a major role in the development and progression of cancer; these range from cyclooxygenase/COX and lipoxygenase/LOX (**Liridona Useini**, Lab 313, 97-36136 and **Sebastian Braun**, Lab 315, 97-36135), to estrogen receptors (**Aleksandr Kazimir**, Lab 315, 97-36135) to various transport proteins or antibiotic/antifungal applications (**Philipp Stockmann**, Lab 312, Tel. 97-36134).

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Selected topics in the field of organometallic chemistry:

Phosphorus chemistry, organometallic chemistry, coordination chemistry, catalysis, materials science.

Phosphorus-rich compounds and their metal complexes

Like hardly any other element, phosphorus, like carbon, tends to build frameworks with element–element bonds, including phosphorus-rich oligophosphanes. In contrast to organic chemistry, despite extensive work in recent decades, phosphorus-rich chemistry has been only poorly studied. Oligophosphane chemistry is both challenging and highly interesting, offering a wide variety of research topics, including the formation of metal complexes.
In particular, our current research focuses on neutral oligophosphanes and their metal complexes, which can also provide access to phosphorus-rich binary metal phosphides MP_x ($x > 1$). These often exhibit interesting catalytic, optical, electronic, and/or magnetic properties. For example, transition metal phosphides can be used as (co-)catalysts in water splitting. (**Volker Eilrich**, Lab 313, 97-36136, volker_ jens.eilrich@uni-leipzig.de)

Current literature from the Hey-Hawkins group on the topic:

T. Grell, E. Hey-Hawkins, *Eur. J. Inorg. Chem.* **2020**, *2020*, 732–736.
T. Grell, E. Hey-Hawkins, *Chem. – Eur. J.* **2020**, *26*, 1008–1012.

For more information, contact the named Hey-Hawkins group members or Prof. Hey-Hawkins.