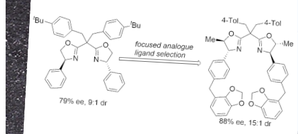
Homogeneous Catalysis Papers of the Month

February 2024

Computational selection

Chemoinformatic catalyst development



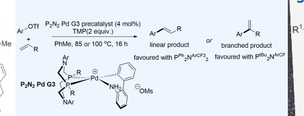
Challenge: High throughput experimentation (HTE) is less frequently used for development of reactions mediated by chiral small molecules.

Solution: HTE and statistical modeling were used to identify Cu-bis(oxazoline) catalysts for vinylogous Mukaiyama aldol reactions, providing ligands with high stereoselectivity.

C. L. Olen et al., *ACS Catal.* **2024**, doi: 10.1021/acscatal.3c05903

Methodology

Selective Mizoroki-Heck reaction



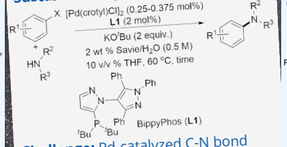
Challenge: It is challenging to control selectivity in Mizoroki-Heck reactions.

Solution: A high throughput evaluation of 1,5-diaza-3,7-diphosphacyclooctane ligands showed their utility in Mizoroki-Heck reactions, producing linear and branched products in high regioselectivity.

E. S. Isbrandt et al., *J. Am. Chem. Soc.* **2024**, doi: 10.1021/jacs.3c14612

In water

Sustainable aqueous Pd catalysis



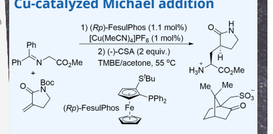
Challenge: Pd-catalyzed C-N bond formations are conducted in organic solvents, which cause issues of toxicity, depletion of petroleum resources, and generation of carbon dioxide.

Solution: $[Pd(crotyl)Cl]_2$ and BippyPhos were employed in an aqueous nanomicellar catalysis of C-N bonds, allowing recycling of both the metal catalyst and the aqueous medium.

K. S. Iyer et al., *JACS Au* **2024**, doi: 10.1021/jacsau.3c00742

Process chemistry

Cu-catalyzed Michael addition



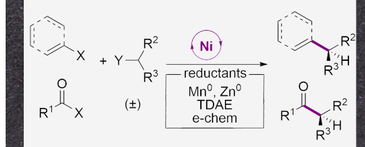
Challenge: The initial synthesis of Nirmatrelvir used high-cost starting materials and cryogenic conditions.

Solution: Three asymmetric catalysis routes were developed, one of which is a Michael addition catalyzed by $[Cu(MeCN)_4]PF_6$ with (*Rp*)-FesulPhos as the ligand.

R. Szpera et al., *ChemRxiv* **2024**, doi: 10.26434/chemrxiv-2024-51d8j

non-PGM catalysis

Ni-catalyzed coupling

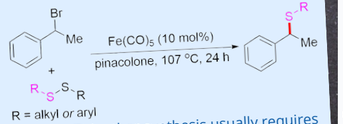


Challenge: Focus on redox-neutral coupling reactions has left reductive cross-couplings poorly understood.

Solution: This Account explores nickel-catalyzed enantioselective reductive cross-coupling reactions, exploring electrophiles, ligands, and reductants.

L.-M. Chen et al., *Acc. Chem. Res.* **2024**, doi: 10.1021/acs.accounts.3c00775

Iron-catalyzed electrophile coupling



Challenge: Thioether synthesis usually requires harsh conditions which lead to undesired side products.

Solution: Benzyl halides were coupled with disulfides using $Fe(CO)_5$, providing good yields (up to 98%) without caustic reagents or elimination pathways.

J. Semenya al., *J. Am. Chem. Soc.* **2024**, DOI: 10.1021/jacs.3c13984

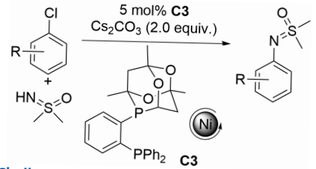
Cu-catalyzed C-O coupling

Challenge: The use of palladium and nickel for C-O coupling has limitations, including cost and toxicity.

Solution: Aryl bromides and aliphatic alcohols were coupled at room temperature with Cu catalysis, using DFT-developed N^1,N^2-diarylbenzene-1,2-diamine ligands.

M. J. Strauss et al., *Angew. Chem. Int. Ed.* **2024**, doi: 10.1002/anie.202400333

Thermal nickel catalysis

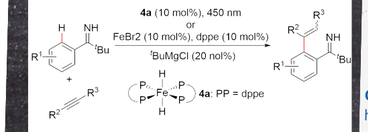


Challenge: Few successful C-N couplings of NH-sulfoximines with (hetero)aryl chlorides have been reported.

Solution: The precatalyst (PhPAd-DalPhos)Ni(*o*-tol)Cl facilitates C-N cross-couplings with (hetero)aryl-X electrophiles under mild conditions.

S. A. Fisher et al., *Org. Lett.* **2024**, doi: 10.1021/acs.orglett.3c04152

Iron photocatalysis

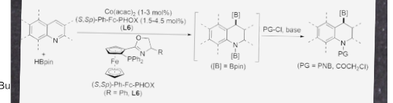


Challenge: Iron-catalyzed reactions can be challenging due to the use of high temperatures and reactive additives like Grignard reagents.

Solution: A C-H alkenylation was catalyzed at room temperature and without additives, by using cis-$[Fe(H)_2(dppe)_2]$ and blue light at 450 nm.

A. M. Messinis et al., *Nature Catal.* **2024**, doi: 10.1038/s41929-023-01105-0

Co-catalyzed hydroboration



Challenge: There are few catalytic systems for hydroboration, and these often result in side products and only moderate activity and selectivity.

Solution: $Co(acac)_2$ with chiral ferrocenyl phosphino-oxazoline and monodentate phosphine ligands catalyzed regio- and stereo-selective cascading hydroboration of quinolines and pyridines.

R. Wang et al., *ACS Catal.* **2024**, doi: 10.1021/acscatal.3c06208

Selected papers from the catalysis literature published online in February 2024 (including pre-prints)