



John F. Hartwig

Vivian Nguyen
Spotlight Presentation
BRG Meeting 11/17/2020



Biography and Education



John Hartwig was born in 1964 and raised in upstate New York. He originally wanted to be an electrical engineer but switched his major once he took chemistry classes in college. He and his family currently live in Berkeley, CA where he enjoys the theatre, opera, and backpacking opportunities. Recently, he's been more outspoken about educating the public on the process of establishing theories to re-engage trust in science.

Education:

- B.A. with high honors from Princeton University in 1986 under Maitland Jones Jr.
 - Studied stereochemistry of photochemical dihalo-carbene source additions to strained alkenes.
- Ph.D from UC Berkeley in 1990 under Richard A. Anderson and Robert G. Bergman.
 - Studied complexes containing ruthenium-oxygen, ruthenium-nitrogen, and ruthenium-carbon bonds.
- Postdoctoral fellowship completed with American Cancer Society at MIT from 1990-1992 under Stephen J. Lippard.
 - Studied Pt-DNA adducts and how they can block DNA replication and bind cellular proteins. Designed and tested and a Pt antitumor drug.

1. Krämer2019-11-13T14:37:00+00:00, K. John Hartwig: 'There's a lot of distrust of science'. <https://www.chemistryworld.com/opinion/john-hartwig-theres-a-lot-of-distrust-of-science/4010522.article> (accessed Nov 17, 2020).
2. Group, H. John F. Hartwig. <https://hartwig.cchem.berkeley.edu/john/> (accessed Nov 17, 2020).

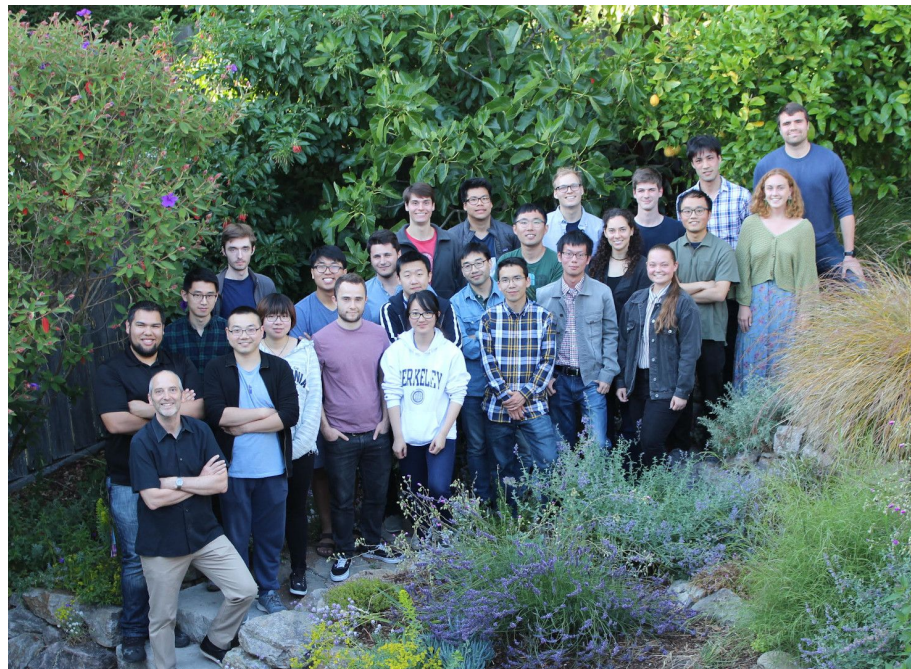
Career and Awards

Career:

- 1992 - 2006: Assistant, associate, and full professor at Yale
- 2006 - 2011: Kenneth L. Reinhart Jr. Professor of Chemistry at University of Illinois Urbana-Champaign
- 2011 - Present: Henry Rapoport Professor of Chemistry at UC Berkeley

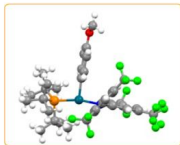
Awards and Acknowledgements:

- 2021 Arthur C. Cope Award for outstanding achievement in organic chemistry
- 2018 Tetrahedron Prize for Creativity in Organic Chemistry
- 2014 Organometallics Senior Fellowship



Research Interests

New Classes of Cross Coupling



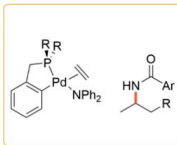
Combinatorial Catalyst Discovery



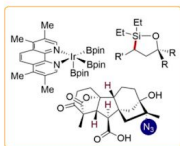
Artificial Metalloenzymes



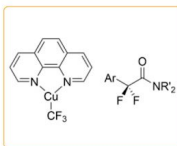
Olefin Hydrofunctionalization



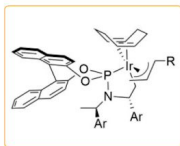
C-H Bond Functionalization



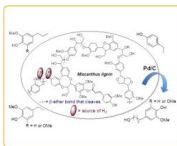
Metal-Catalyzed Fluorination and Fluoroalkylation



Iridium-Catalyzed Allylic Substitution



Catalysis for Renewable Chemicals and Fuels



Interested in transition metal -catalyzed reactions to develop more practical synthetic methods.

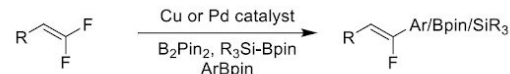
- New Classes of Cross Coupling: Developed a Pd-catalyzed process that forms arylamines, aryl sulfides, and arylethers. The findings have been used in syntheses and medicinal chemistry.
- Artificial Metalloenzymes: Developing methods to combine reaction diversity of organometallics with enzyme selectivity.
- Metal Catalyzed Fluorination and Fluoroalkylation: Finding catalytic methods to convert arenes, heteroarenes, aryl halides and heteroaryl halides to products with fluorine and fluoroalkyl groups. These products are also studied for their reactivity and can be used in drugs and agrochemicals.

Copper-Catalyzed Defluorinative Borylation and Silylation of gem-Difluoroallyl Groups

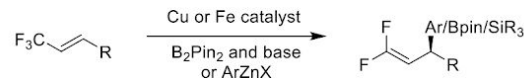
- (Z)-fluoroalkenes are similar to functional groups used in bioactive and medicinal molecules. Can specialize in changing properties like lipophilicity and metabolic stability.
- E/Z ratio is hard to control
- S_N2' defluorinative borylation and silylation used to make primary 3-fluoroallylboronic esters and 3-fluoroallylsilanes from 3-substituted-3,3-difluoropropenes, with good Z selectivity.

Scheme 1. Transition-Metal-Catalyzed Synthesis of Fluoroalkenes by C–F Activation

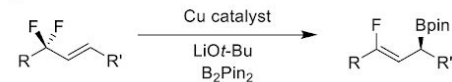
A. S_NV Activation of 1,1-Difluoroalkenes



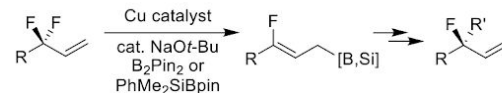
B. S_N2' Substitutions of Trifluoromethyl Alkenes



C. S_N2' Borylation of Internal gem-Difluoropropenes

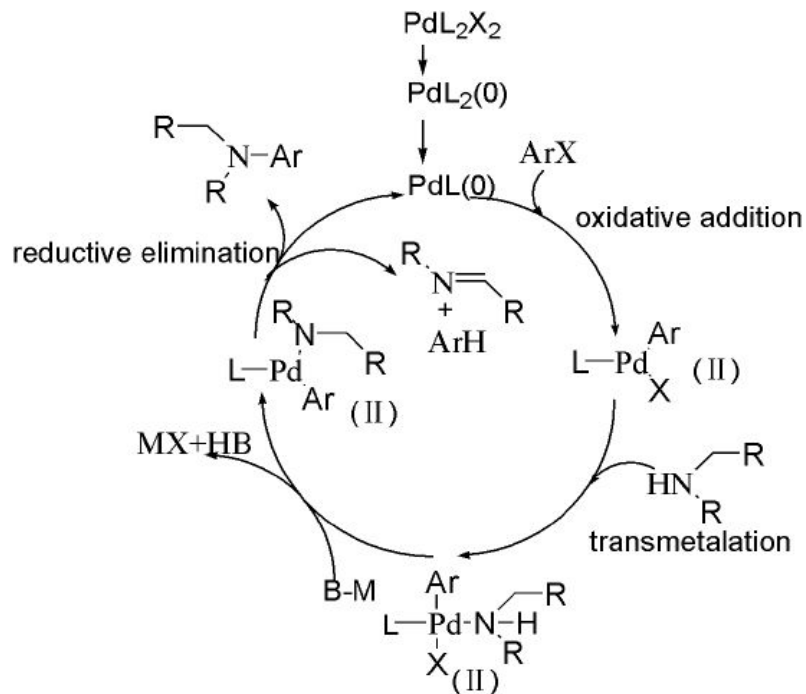


D. This Work. S_N2' Borylation and Silylation of Terminal gem-Difluoropropenes and Subsequent Allylic Rearrangements



- High stereoselectivity
- Primary 3-fluoroallylic boronic esters
- Readily-available materials
- Precursors to tertiary allylic fluorides

Buchwald-Hartwig Amination (catalytic cycle)



Palladium-catalyzed cross-coupling of amines and aryl halides to make C-N bonds.

- Originally suggested by Kosugi, Kameyama and Migita in 1983.
- Hartwig found intermediates during the C-N bond formation which showed oxidation addition and reductive elimination. Buchwald improved the reaction by making it more available to more arylamine substrates through transamination and Pd cross-coupling.
- Reaction provides amines in good yield but is sensitive to certain functional groups like azo, esters, or nitro groups. Uses Buchwald ligands.