

Prof. Ernst Otto Fischer and Prof. Geoffrey Wilkinson

Max Shi and Jeremy Meyerberg

Prof. Fischer and Prof. Wilkinson



Professor Ernst Otto Fischer
Technical University, Munich, Federal Republic
of Germany
November 10, 1918 - July 23, 2007



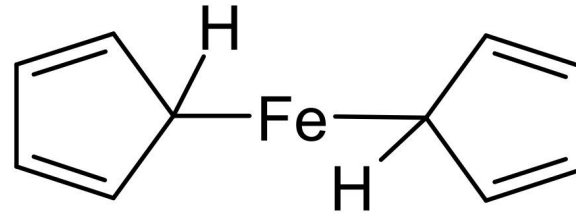
Professor Geoffrey Wilkinson
Imperial College, London, United Kingdom
July 14, 1921 - September 26, 1996

1973 Nobel Prize for Chemistry

- Awarded jointly “for their pioneering work, performed independently, on the chemistry of organometallic, so called sandwich compounds.”
- Prepared dicyclopentadienyl iron (ferrocene) in 1951, at the same time
- Compound was extraordinarily stable chemically and thermally
- Insufficiently explained by ionic-covalent resonance



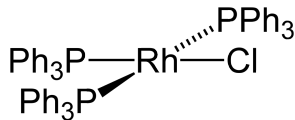
Ferrocene



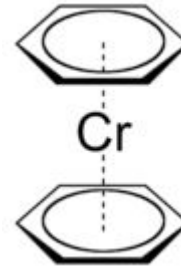
Previously proposed structure of
ferrocene

1973 Nobel Prize for Chemistry (cont.)

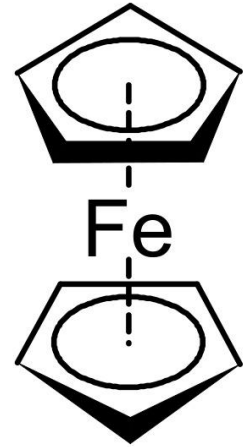
- Fischer used x-ray crystal structure determination to establish true geometry of compound.
- Wilkinson used chemical, physical, and spectroscopic (NMR) studies for the same conclusion.
- Contributed to the creation of the field of “metallocene chemistry”
- Fischer and Wilkinson were also consistent contributors to the new field
 - Fischer went on to create bis-benzene chromium
 - Wilkinson also created Wilkinson’s catalyst, used for hydrogenation of alkenes



Wilkinson's Catalyst

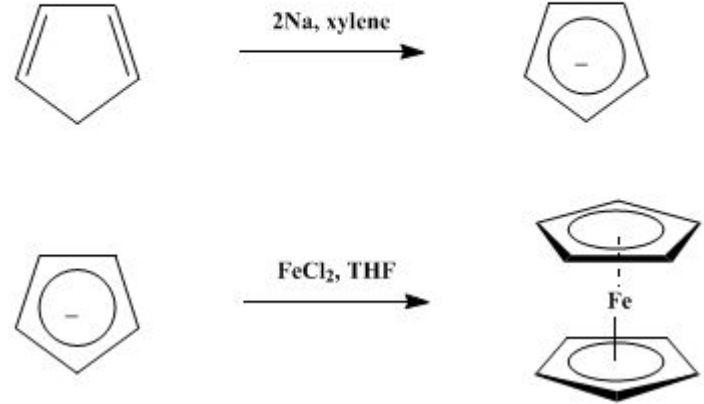
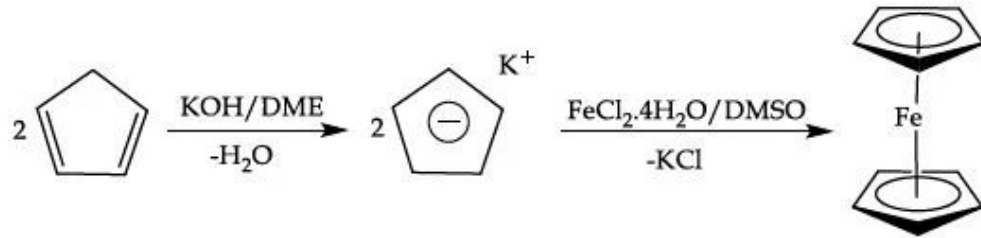
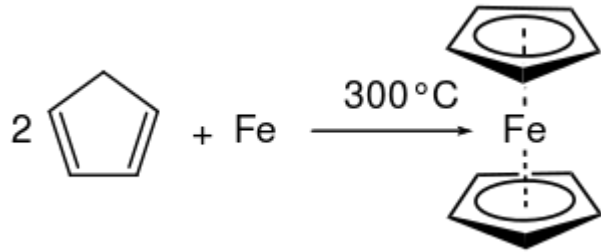


Bis-benzene chromium



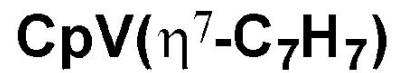
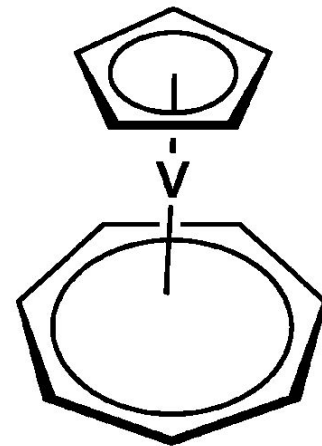
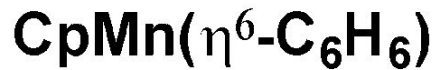
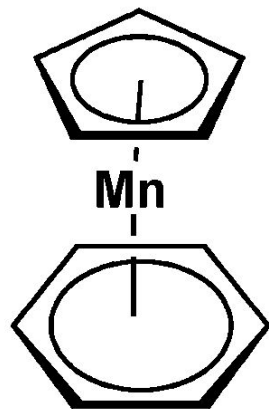
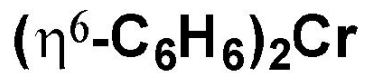
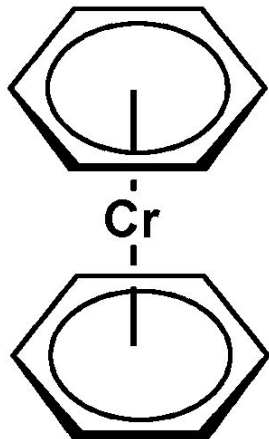
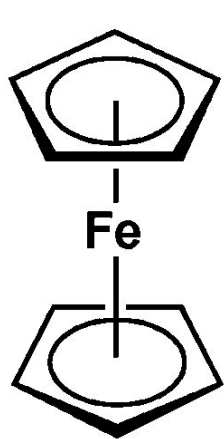
Ferrocene

Mechanism of the Reaction

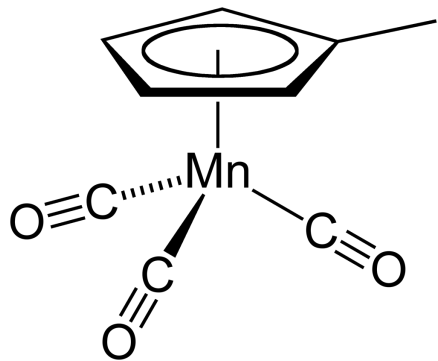


- Reaction is between the d-orbitals of Fe^{2+} with the p-orbitals of two cyclopentadienyl ligands

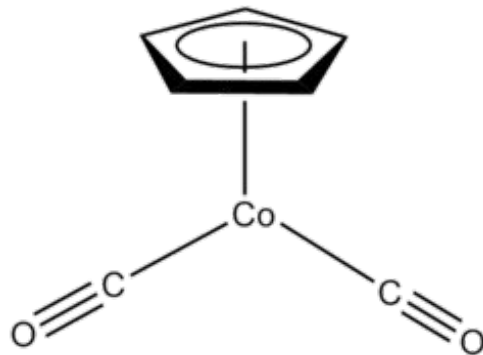
Examples of Sandwich Compounds



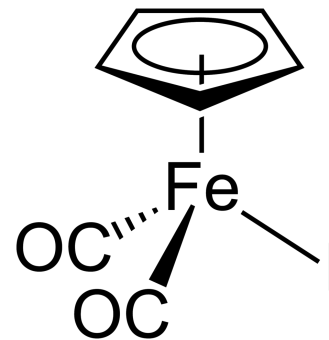
Half-Sandwich Compounds



Antiknock Agent

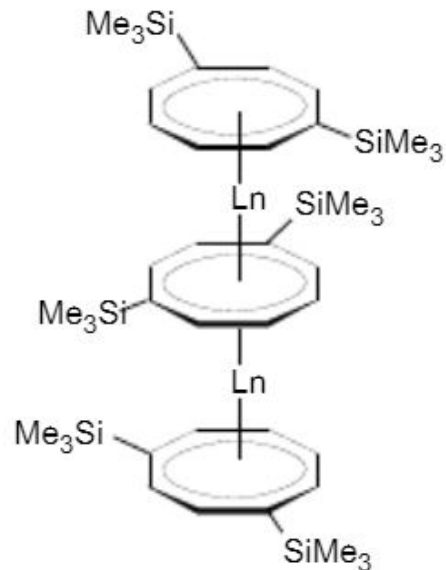
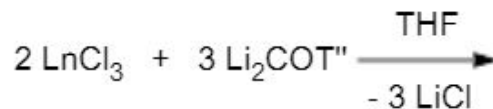
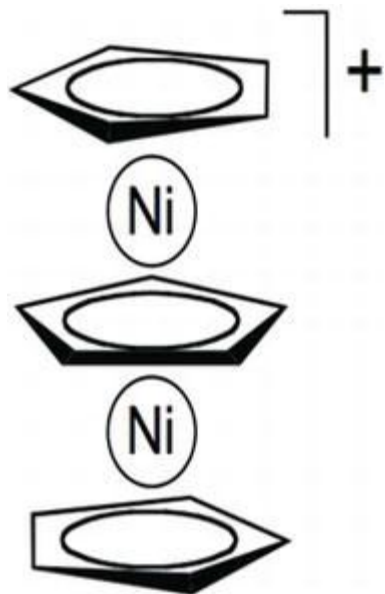


Catalyst for Pyridine Synthesis

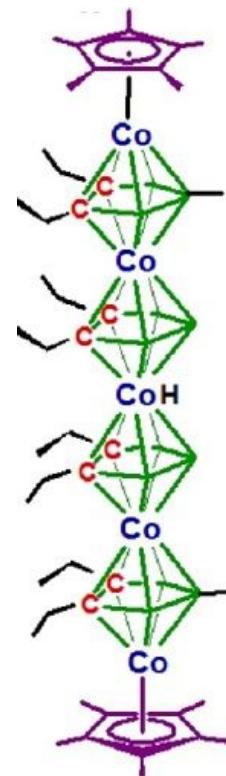


Intermediate in preparation of organoiron compounds.

Multidecker Sandwich Compounds



Lanthanide Triple Decker Sandwich



Cobaltacarborane hexadecker

Application of Sandwich Compounds

- Fuel additive
 - Anti-knock compounds that reduce engine knocking and increase a fuel's octane rating
- Half-sandwich compounds catalysts for transfer hydrogenation
 - Addition of hydrogen without using gaseous H_2
- Various catalysts for reactions
- Some bent metallocenes are precatalysts for polymerization of propylene



1, M = Zr, Hf

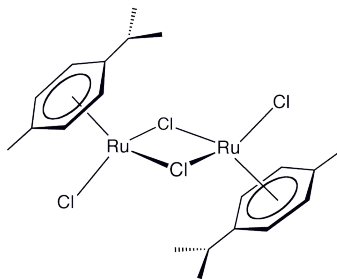


2, M = Zr, Hf

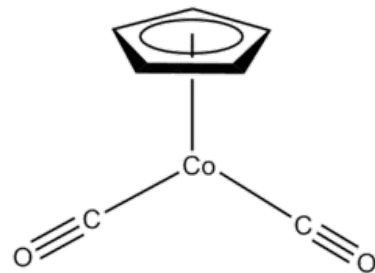


3, M = Zr, Hf

Compounds used for polymerization



Derivatives of this sandwich used for transfer hydrogenation

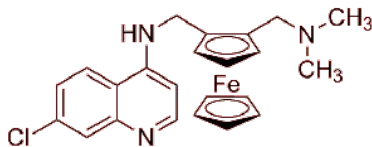


Catalyzes formation of pyridines from alkynes and nitriles

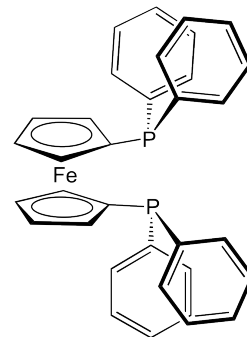
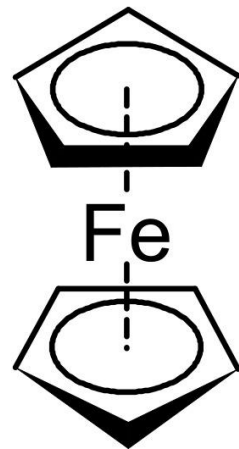
Application

Ferrocene

- Catalyst for the production of carbon nanotubes
- Ligand scaffold
- Safer fuel additives
 - Replaced tetraethyllead as anti-knock agent
 - Provide rocket propellant with heat stability
 - Reduces smoke and sulfur trioxide generation in burning coal
- Pharmaceuticals
 - Ferroquine is an antimalarial in clinical trials
 - Anticancer properties



Ferroquine



1,1'-Bis(diphenylphosphino)ferrocene,
used for palladium coupling reactions

Works Cited

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