CH 609
Spring 2008
Literature Review Paper

The goal of this class is to expose you to the key mechanisms of organometallic chemistry and methods for their determination. Using this knowledge base, you should be able to understand the mechanism of all metal-mediated or catalyzed reactions. This assignment is designed to give you a chance to apply this knowledge to describing a specific catalytic reaction that is used in industry and/or organic synthesis.

Choice of topic: Below I have listed a number of important transition-metal catalyzed reactions. This is in no a way an exhaustive list, but is only meant to provide you with suggestions. You may choose one of the topics below, or you may choose your own topic. If you decide to choose your own topic, you should pick a catalytic cycle where the metal is intimately involved in bond formation or breaking (i.e., Lewis acid catalyzed reactions, while important, are not really relevant to this class). Once you have settled on a topic, email me (kshaughn@bama.ua.edu) to reserve your choice and get my approval. If two people request the same topic, the first person to request the topic will have priority.

Writing the Paper: Your assignment in writing these papers is to provide a detailed review of the development of your catalytic cycle, its mechanism, and its current applications. I do not want an exhaustive review of every example of this catalytic cycle in the literature. Instead, your paper should be sufficiently focused that you can give a detailed description in the allotted space. Some of the suggested topics below are fairly broad. In these cases it will be best to focus on a specific class of catalysts, substrates, or selectivity within the broad topic (i.e.: Zirconocene Catalysts for Stereoblock Polypropylene Formation). It is OK to choose a broad topic initially, and then decide on a narrow focus after the deadline to choose your topic.

Suggested organization of your paper:

- Describe the early reports of the catalytic reaction you are reviewing.
- Discuss in detail the mechanism of the catalytic cycle. Focus your discussion on how the mechanism has been determined.
- If possible, describe efforts to apply the mechanism to designing improved catalytic systems.
- Discuss the current "state-of-the-art" system(s) and the types of problems to which they are being applied.
- Briefly discuss current limitations of the catalyst systems, or areas of future research.

With this assignment, we are going to try to simulate the process by which peer reviewed articles are accepted to journals. You will write your paper and submit it for peer review (by me and your classmates). Based on the reviewer comments, you will revise your manuscript before turning in the final draft.

Formatting Requirements

Title Page: The first page of your paper must be a title page with your name and the title of your paper. The text of your paper should start on page 2.

Text: Your paper should be no more than 10 pages long (not including references) double spaced with standard size fonts and margins (12 pt Times or 10 pt Helvetica/Arial and 1" margins suggested). References, should be formatted using *JACS* style, but with **paper titles included** (see recent issue or the JACS web site).

Graphics: Chemical structures should be drawn using ChemDraw or similar programs using the *J. Amer. Chem. Soc.* drawing settings (these settings are available in ChemDraw or can be found in the first issue of *JACS* or its web site). Copies of literature graphics will not be acceptable (i.e. this is plagiarism) unless they could not be reproduced using standard drawing programs (i.e., published spectra, graphs, etc). Drawing programs should be available on computers in most of your labs. If you cannot find access to ChemDraw or a similar program, let me know.

Review process:

The review process will be conducted electronically. By the deadline for the first draft, you should submit your paper to me electronically (by email) in PDF format. Two copies of your paper will be distributed by email to randomly selected class mates. They, along with I, will review your paper using forms that I will provide. I will collect all of the reviews and return them to you anonymously. Part of your grade on this project will be based on how thoughtfully you carried out your review duties, so please take this seriously.

Final Draft:

Use the comments of the reviewers to revise your paper. You will need to turn in the following by April 25th.

- The final draft of your paper
- The reviewer comment sheets
- A brief discussion of how you addressed the reviewers concerns. If you feel that some of the reviewers comments were invalid or incorrect, explain why you felt that way.

Important Dates:

- **February 22nd:** Deadline to choose your paper topic (note, this is later than in syllabus).
- **March 12th:** A draft of your paper is due.
- **March 31st:** Paper reviews due
- **April 25th:** Final Draft of your paper is due.

Some suggested topics:

- Olefin oligomerization and polymerization
  - Metallocene Catalysts for Olefin Polymerization
  - Constrained-Geometry Catalysts for Olefin Polymerization
  - Stereoselective Polymerization of Higher Olefins with Metallocenes
  - Late-Metal Catalysts for Olefin Polymerization
  - Co-polymerization of olefins and CO
  - Ring Opening Metathesis Polymerization (ROMP)
  - Acyclic Diene Methathesis Polymerization (ADMET)
  - Shell Higher Olefin Process (SHOP)
  - Telomerization of Butadiene
  - Cyclotrimerization of Alkynes
  - Trimerization and/or tetramerization of ethylene
  - Alkene Dimerization

- C-H Functionalization
  - Alkane dehydrogenation (alkane → alkene)
  - Alkane Borylation (alkane → alkylborane)
  - Alkane Carbonylation (alkane → aldehyde)
  - Selective Alkane Oxidation (alkane → alcohol, etc)
  - Murai Reaction

- Carbonylation
  - Acetic acid synthesis
  - Alkene Hydroformylation
  - Alkene Hydrocarboxylation
  - Pauson-Khand Reaction

- Additions to Alkenes and Related Reductions
  - Hydrocyanation
  - Alkene hydrogenation--Wilkinson's Catalyst
  - Asymmetric Hydrogenation of alkenes
  - Atom-Transfer Hydrogenation
  - Arene Hydrogenation
  - Alkene Hydrosilylation
  - Ketone Hydrosilylation
  - Metal Catalyzed Hydroboration
  - Decarbonylation of Aldehydes
  - Reduction of CO to methanol

- Oxidation
  - Sharpless Epoxidation of Allylic Alcohols
  - Asymmetric Epoxidation
  - Asymmetric Dihydroxylation
  - Palladium-catalyzed aerobic oxidation of alcohols.
  - Aminohydroxylation

Wacker Oxidation
Amine Addition to Alkenes

Coupling Reactions
Heck Coupling
Suzuki Coupling
Stille Coupling
Sonagashira Coupling
Hartwig-Buchwald Amination
Arylation of Enolates
Copper-Catalyzed Couplings (Ullmann Coupling)

Miscellaneous
Asymmetric Allylic Substitution
Rhodium-Catalyzed Carbene Insertions
Ring-Closing Metathesis
Diene Cyclization
Enyne cyclization
Alkene Carbometalation