

Chemistry 575: Topics in Organometallic Chemistry
Spring 2018, Rutgers University, Newark
Syllabus
Lecture: Thursday, 6:00-8:50 PM, Smith Hall, 240

Professor Michal Szostak, Olson 204
michal.szostak@rutgers.edu

Office hours: By appointment.

Course Synopsis:

Fundamental principles and advanced topics in organometallic chemistry. Properties and mechanisms of transition metals are covered in detail, with emphasis on recent advances in reactivity, ligand design and reaction development. Special attention is given to organometallic processes of industrial interest and the emerging trends in reactivity.

Required Text:

- *The Organometallic Chemistry of the Transition Metals*, 6th Ed. Crabtree, R. H. (4th or 5th Ed. is also acceptable)

Recommended Texts (Optional):

General organometallic chemistry textbooks:

I have requested that the following texts are on reserve in Dana Library this semester:

- *Organotransition Metal Chemistry: From Bonding to Catalysis*. Hartwig, J.
- *Organometallic Chemistry*. 3rd Ed. Spessard, G. O.; Miessler, G. L.
- *Organometallics*. 3rd Ed. Elschenbroich, C.
- *Transition Metals in the Synthesis of Complex Organic Molecules*. 3rd Ed. Hegedus, L.; Soderberg, B.
- *Advanced Inorganic Chemistry*. 6th Ed. Cotton, F. A.; Wilkinson, G.; Murillo, C. A.; Bochmann, M.

General organic chemistry textbooks: (you should be familiar with the vast majority of material in the following books prior to taking this class):

- *Strategic Applications of Named Reactions in Organic Synthesis*. Kurti, L.; Czako, B.
- *Advanced Organic Chemistry, Part B: Reactions and Synthesis*. Carey, F. A.; Sundberg, R. J.
- *The Art of Writing Reasonable Organic Reaction Mechanisms*. 2nd Ed. Grossman, R. B.

List of other resources in organometallic chemistry:

- *New Trends in Cross-Coupling: Theory and Applications*. Colacot, T. J.
- *Transition Metal Reagents and Catalysts: Innovations in Organic Synthesis*. Tsuji, J.
- *Metal Catalyzed Cross-Coupling Reactions and More*. de Meijere, A.; Bräse, S.; Oestreich, M.
- *Handbook of Organopalladium Chemistry for Organic Synthesis*. Negishi, E.
- *Palladium in Heterocyclic Chemistry*, 2nd Ed. Li, J. J.; Gribble, G. W.

Grading:

Breakdown:

Seminar presentation: 20%**Final project (written):** 20%**Quizzes:** 20%**Final Exam:** 40%**Approximate Class Outline:**

Week	Date	Lecture	Topic
1	Jan 18	Lecture 1	General properties of transition metals
2	Jan 25	Lecture 2	Basic organometallic reaction mechanisms
3	Feb 1	Lecture 3	C–C Bond forming reactions, cross-couplings
4	Feb 8	Lecture 4	Hydrogenation
5	Feb 15	Lecture 5	Hydrosilylation, hydroboration
6	Feb 22	Lecture 6	Hydroformylation, carbonylation, hydroacylation and related reactions
7	Mar 1	Lecture 7	Seminar Presentation
8	Mar 8	Lecture 8	Case studies
9	Mar 15		Spring Break
10	Mar 22	Lecture 9	Olefin metathesis
11	Mar 29	Lecture 10	Nu attack on olefins, hydrofunctionalizations
12	Apr 5	Lecture 11	π -Allyl chemistry
13	Apr 12	Lecture 12	C–H Activation
14	Apr 19	Lecture 13	Ligand design 1, case studies, industrial applications
15	Apr 26	Lecture 14	Ligand design 2, case studies, industrial applications
Finals	May 3		Final Exam, Final Project Due

Exam:

Exam will be closed book, closed note. Exam will cover lecture material, seminar presentations, assigned reading and literature discussed in class.

Midterm Presentation:

Each student will be asked to present a short seminar (20-30 min) based on an original research paper (review) from the current organometallic literature. The selection of papers will be given early in the semester. The presentation should cover the most important aspects and references from the assigned topic. Each presentation should include the following: (i) background and current state-of-the-art; (ii) the most important aspects (synthesis, scope, mechanism, choice of transition metal); (iii) novelty of the presented work; (iv) future applications and extensions. Future applications and extensions may include work covered in the assigned paper (review) or by others. **Your goal is to provide a comprehensive and balanced overview of the relevant topic to the class.** The presentation will be graded as 20% of the final grade. Grading will include content, presentation and clarity.

Final Project:

Each student will be asked to review an organometallic problem based on an original research paper from the current organometallic literature and prepare a 3-page review article in *ACS communication format*. The review article should cover: (i) the most important aspects (synthesis, mechanism, scope, choice of transition metal); (ii) cited references and background; (iii) follow-up work from the assigned topic. **The review should be a critical summary of the assigned topic, and not simply a description of the lead paper.** The selection of papers will be given after the midterm presentation. The review article should be formatted using standard ACS template (ChemDraw drawings, ACS settings). The review should be submitted in an electronic format (as a .pdf file) The project will be graded as 20% of the final grade. The final project is due at the time of the final exam. The reviews will be compiled and distributed to the class after the final exam. Grading will include content, presentation and clarity.

Learning Objectives:

After completion of this course students should:

- be familiar with modern methods in organometallic chemistry with focus on properties and mechanisms of transition metals
- be familiar with major classes of transition metals and their chemical properties
- be able to predict reactivity of different classes of organometallic complexes
- be familiar with recent advances in reactivity, ligand design and reaction development in organometallic chemistry
- be familiar with commonly used synthetic routes to organometallic complexes
- be able to plan synthetic routes to complex organic molecules using organometallic transformations
- be familiar with the major advances in ligand design and with the current state-of-the-art methods in organometallic chemistry
- be familiar with general synthetic approaches used in ligand synthesis, general principles of ligand selection, synthetic methods in major industrial organometallic processes, their mechanistic basis, scope and limitations
- be familiar with major journals and publications in organometallic chemistry
- be able to critically evaluate organometallic literature, present seminars and short reviews in organometallic chemistry

Attendance Policy:

Please, review Rutgers University attendance policy, which can be found at <http://policies.rutgers.edu/view-policies/academic-%E2%80%93-section-10#2>

Academic Integrity Policy:

Please, review Rutgers University Academic Integrity Policy, which can be found at <http://academicintegrity.rutgers.edu/academic-integrity-policy>. This policy applies to all Schools and Colleges of Rutgers, the State University of New Jersey, including the Ernest Mario School of Pharmacy and the Rutgers College of Nursing.