

CHEM 4620 (Fall 2010)

Advanced Topics in Inorganic Chemistry:
Catalysis - Principles and Industrial Applications

Undergraduate prerequisites: CHEM 3640, CHEM 3650, CHEM 3750, CHEM 3870

Cross-listed with CHEM 710/7100 (Fall 2010)

(GWC)² Graduate Course

Exclusion: CHEM 7105/01 as offered in Winter 2010

Time: Fall 2010; W 7:00-9:20PM ROZH 106/C2-278

Synopsis:

This course will provide an introduction into the principles of hetero- and homogeneous catalysis as effected by man-made and typically metal-based catalysts. The kinetic and thermodynamic parameters of catalysis, the elucidation of catalytic mechanism by various techniques and important applications of catalysis in industrial processes and their socio-economic importance will be discussed.

Highly Recommended Textbook:

Catalysis: Concepts and Green Applications

Gadi Rothenberg

Wiley-VCH; 2008

ISBN: 978-3-527-31824-7

<http://www.catalysisbook.org/>

Cost: ~ 80 CAN\$

Evaluation:

Midterm exam: **30 %**

Presentation: **35 %**

Each student in the course will be required to give a 20-30 min. presentation (PowerPoint or OpenOffice/max. 20 slides) on a topic of his/her choice within the field of catalysis. In order to coordinate this effort and avoid overlap, I will suggest and discuss potential topics in the first class.

Term paper in form of a 5+1 page NSERC format review (undergraduate students) or research proposal (graduate students): **35 %**

The presentation and term paper cannot be on the same topic !

Tentative topics of lectures (12 Weeks):

- 1) What is Catalysis ? – Concepts, Definitions, Environmental Relevance and a Historic Perspective.
- 2) Principles, Composition and Reactivity Patterns of Heterogeneous Catalysts – Metals, Promoters, Supports, Surfaces and Defects.
- 3) Principles, Composition and Reactivity Patterns of Homogeneous Catalysts – Rational Design, the Role of Ligands and Wilkinson's Catalyst.
- 4) Enzymes as Catalysts.
- 5) Kinetic Analysis of Catalytic Reactions for the Elucidation of Mechanisms.
- 6) Solid Acid/Base Catalysts: Cracking and Reforming of Fossil Carbon Resources.
- 7) Industrially Important Heterogeneous Hydrogenation and Oxidation Catalysts.
- 8) The Wacker Process, Fischer-Tropsch Chemistry and Hydroformylation as Examples of Industrially Important Homogeneously Catalyzed Processes.
- 9) Catalytic Carbon-Carbon Bond Formations.
- 10) Nobel Prizes for Homogeneous Catalysis: From Knowles to Grubbs.
- 11) Student Lectures.
- 12) Student Lectures.