PARTNERSHIP FOR INTERNATIONAL RESEARCH AND EDUCATION

UCSB

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science crossing borders...

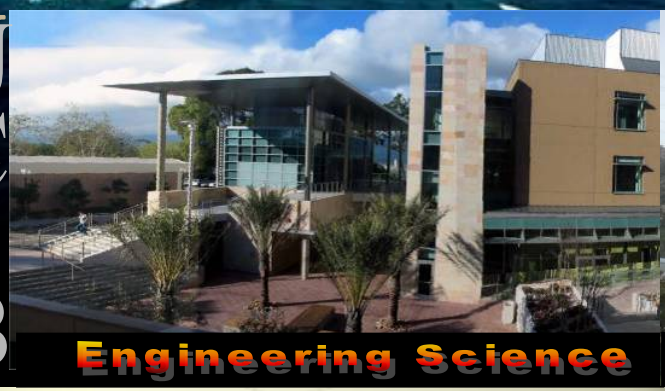
中国科学院大连化学物理研究所

DALIAN INSTITUTE OF CHEMICAL PHYSICS, CAS

Research in Dalian: a Student's Perspective

一个学生的感想

Robert Savinelli
University of California
Santa Barbara
向荣柏



Engineering Science

Biotechnology Center

UCSB DICP

INTRODUCTION

I have completed four months of research in the catalyst laboratory of Professor Bao Xinhe. Before leaving, my Mandarin language proficiency could be described as quite limited. My interest in China was based on a respect for their scientific accomplishments, a curiosity about the global effects of Chinese industrialization, a desire to become familiar with the widely spoken Mandarin language, and the ability to do research that overlapped with my work at UCSB.

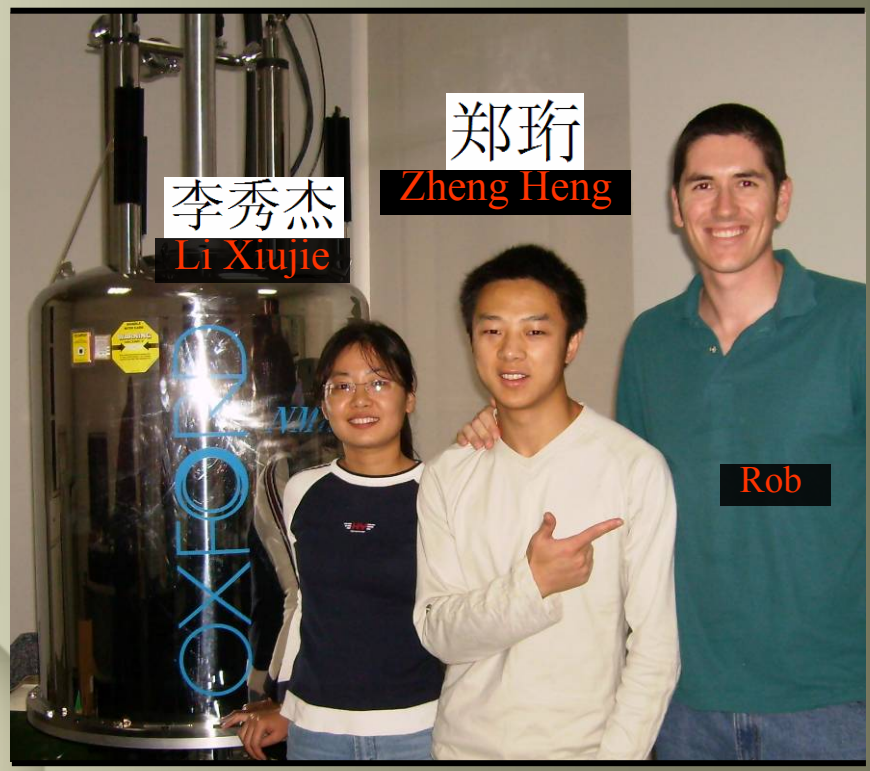
Distinguished Professors who Have Facilitated my Experience

大连化学物理研究所

Office of Basic Energy Sciences
Serving the Present, Shaping the Future

This work was partially supported by under a grant from the National Science Foundation no. OISE-0530268

Chinese Students from DICP will study Chemistry in Santa Barbara



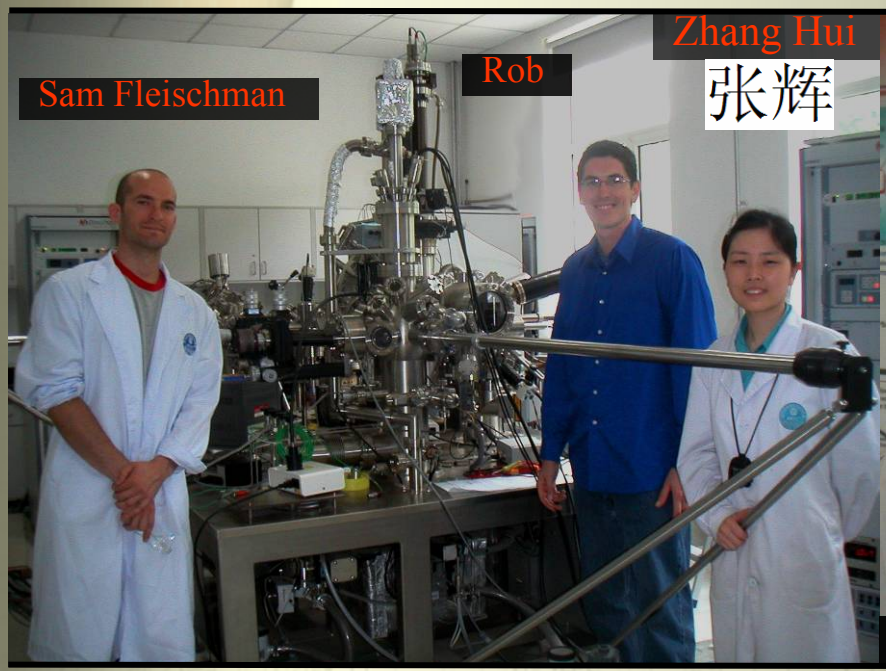
- The NSF PIRE-ECCI program is funded for Five years.
- Each year 6 American students will come to China.
- Each year 4 or 5 Chinese students will come to America.
- Student research visits will be 4-6 months.

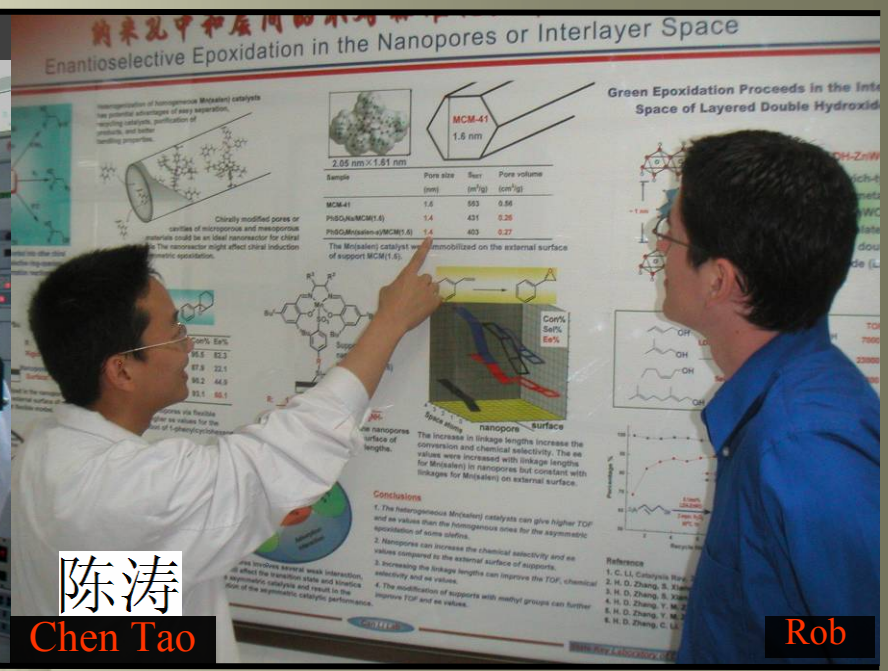
pire ecci Electron Chemistry Catalysis Interfaces

Why am I interested in China? 为什么来中国

UCSB

- Respect for SCIENCE IN CHINA.
- Global effects of Chinese development.
- Chinese LANGUAGE.
- RESEARCH OVERLAP between DICP and UCSB.

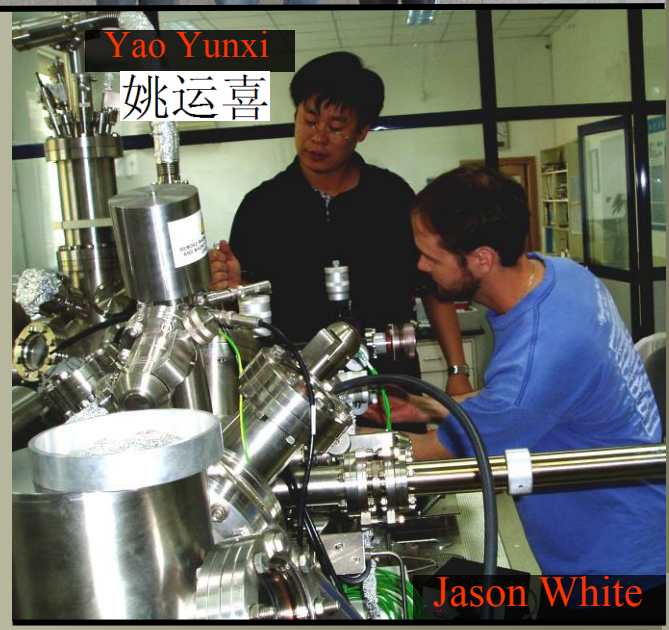




Catalysis: is the science behind making SLOW reactions happen FASTER.

What have I Gained from this Experience? 我的收获

- NEW International Colleagues
- IMPROVED Language Skills
- Experimental DATA
- Technical TRAINING



第十三届全国催化会议

Photo's from Professor Bao's Laboratory in Dalian

中国科学院大连化学物理研究所
DALIAN INSTITUTE OF CHEMICAL PHYSICS, CAS

中国大连

Extended PIRE ECCI visit to DICP.

Research Overview

University of California - Santa Barbara

Dalian Institute of Chemical Physics

Robert Savinelli

6/13/2006 – 8/12/2006

9/14/2006 – 11/14/2006

UCSB

Introduction

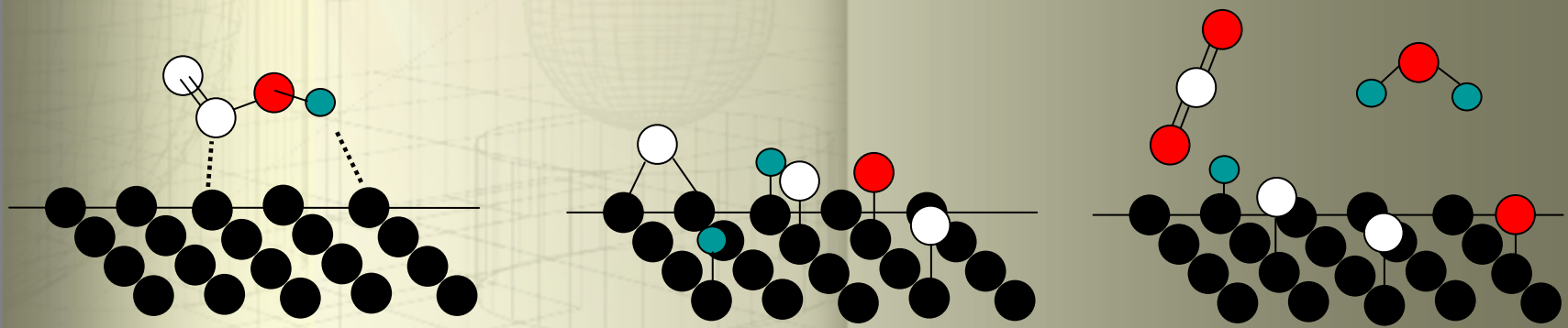
Chemistry at the Gas – solid interface

Metal catalysts provide a surface for gas phase reactions to occur. Activity is generally a function of electronic properties and accessibility. Gas phase and surface atoms need enough attraction for adsorption. If the interaction is too strong desorption will not happen.

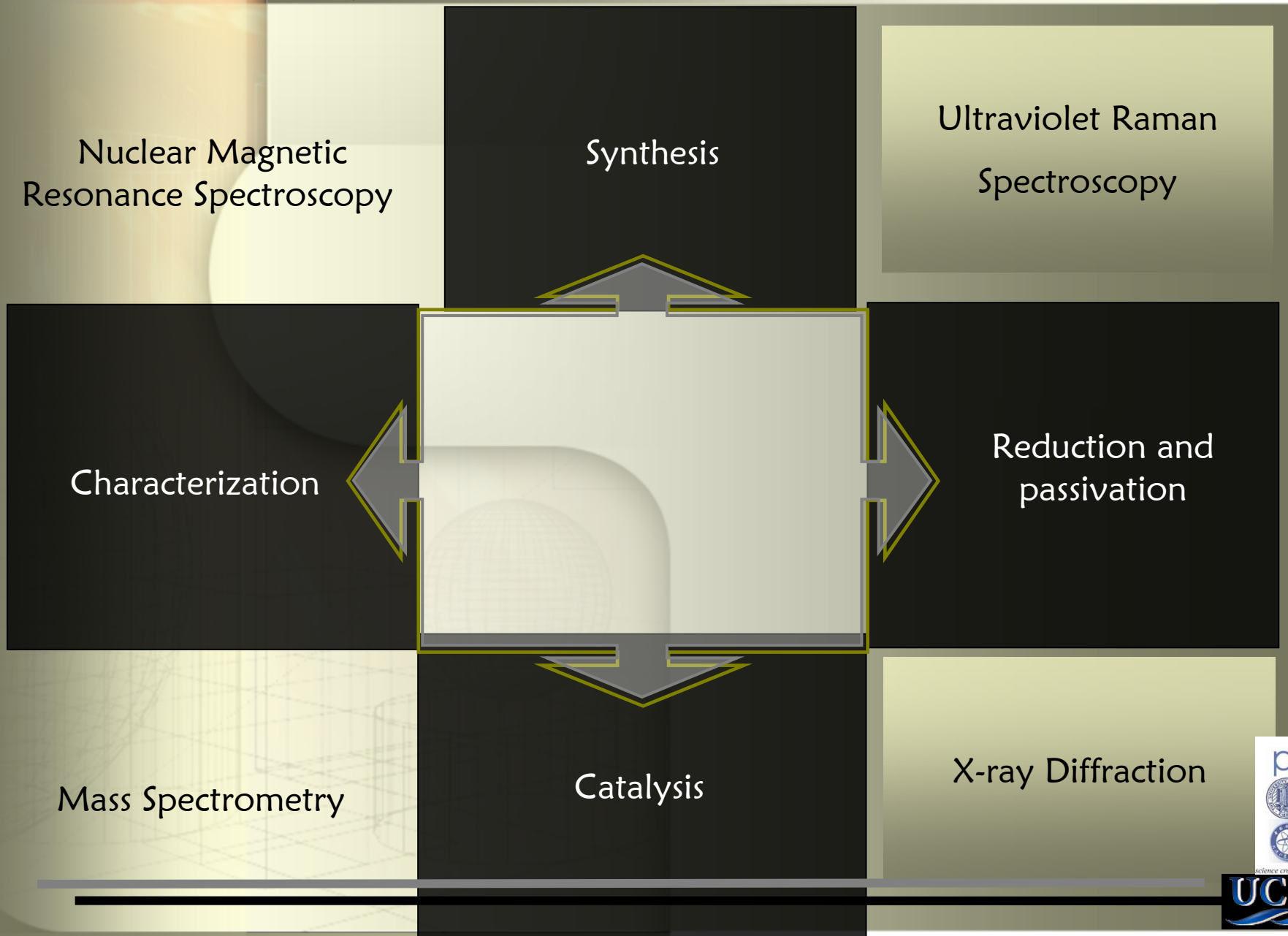
Adsorption

Rearrangement

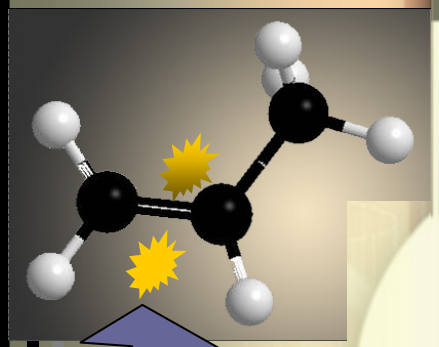
Desorption



My Experiments at DICP



Olefin Chemistry



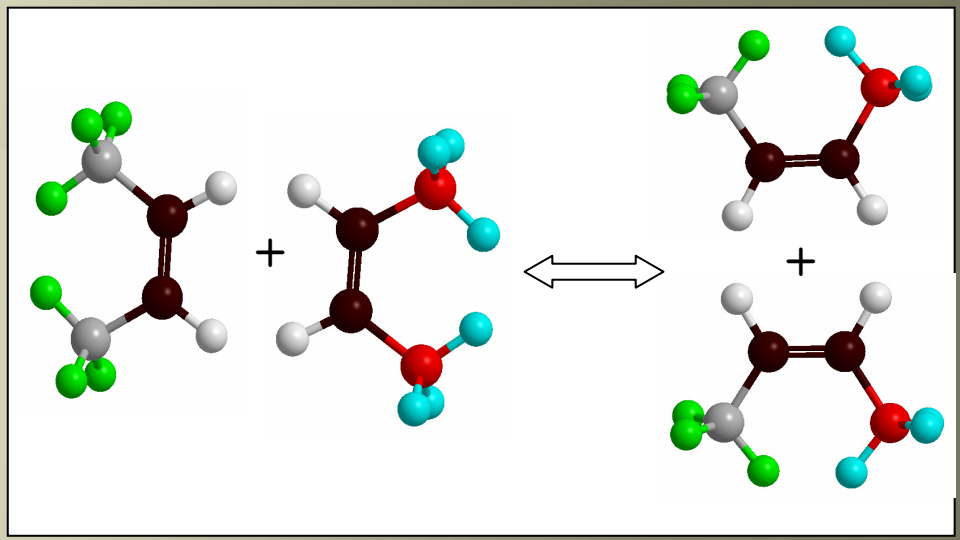
An olefin is a hydrocarbon molecule containing at least one double bond.

Added electron density around the double bond makes the olefin more reactive than their saturated paraffin analogs.

Light olefins are the main feedstock for the chemical industry. Ethylene and propylene are needed for the manufacture of plastic.

Hydrogenation
Metathesis
Polymerization
Epoxidation
Halogen Substitution

Olefin Metathesis Catalysts



Cross-metathesis – the reaction between two different molecules to form 2 that are the same.

A + B = 2 C

$C_2H_4 + C_4H_8 = 2\ C_3H_6$

Organometalic Ru and Mo catalysts – Grubbs and Shrock

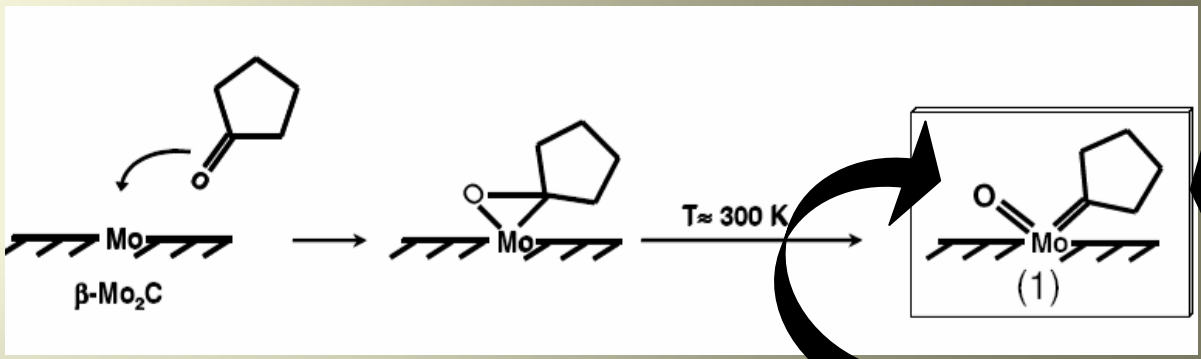
Methyltrioxorhenium (MTO) on SiO_2/Al_2O_3

Molybdenum oxide (MoO_3) on Alumina and Zeolite

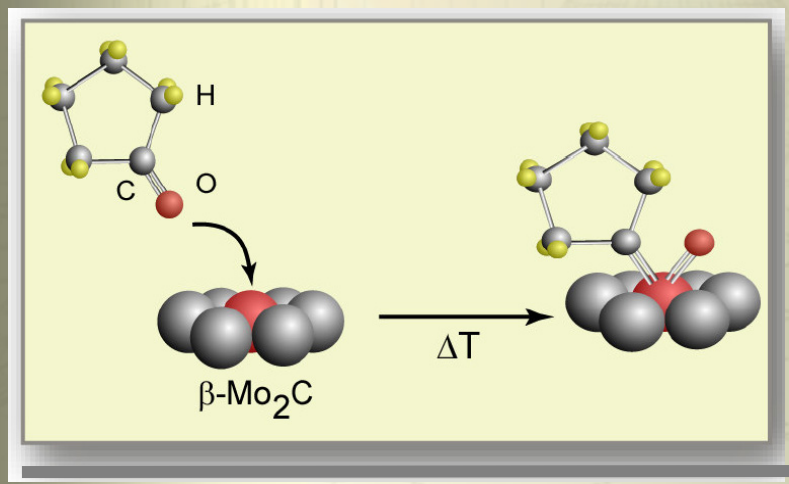
Ketone activated molybdenum carbide

Mo_2C Metathesis Active Site Formation

Cyclopentanone undergoes disassociative adsorption to form a surface carbene species.

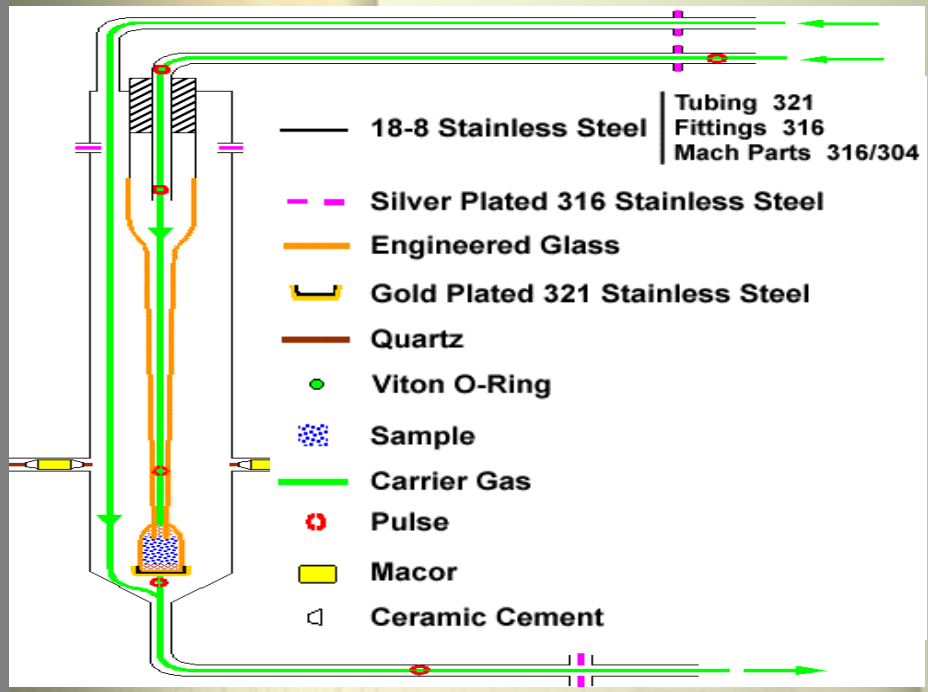


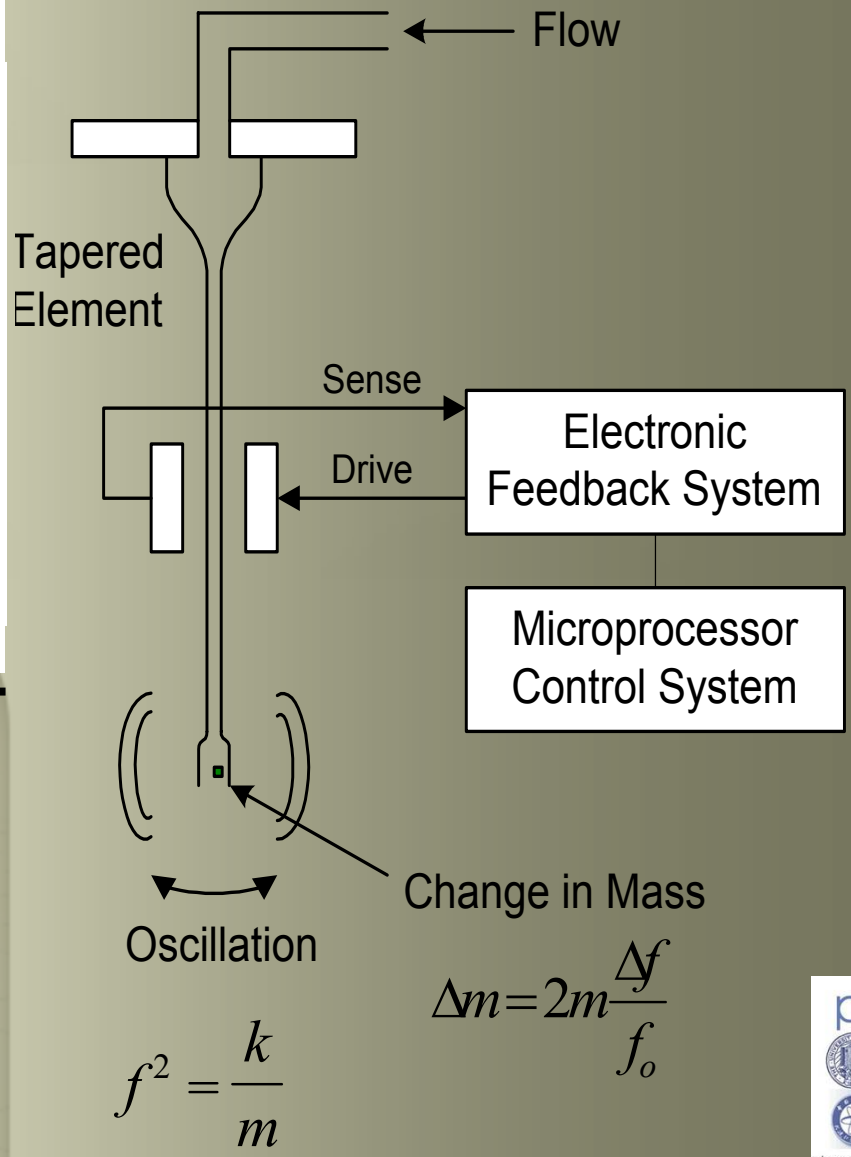
Proposed carbene formation



M. Siaj, I. Temprano, N. Dubuc, P.H. McBreen, Preparation and Olefin-Metathesis Activity of Cyclopentylidene-Oxo Initiator Sites on a Molybdenum Carbide Surface, Journal of Organometallic Chemistry (2006), doi: 10.1016/j.jorganchem.2006.09.033

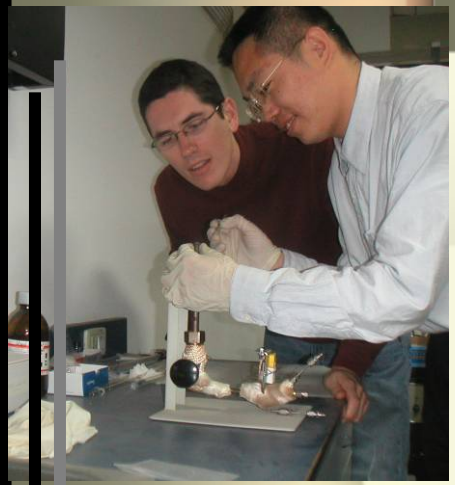
TEOM Tapered Element Oscillating Microbalance



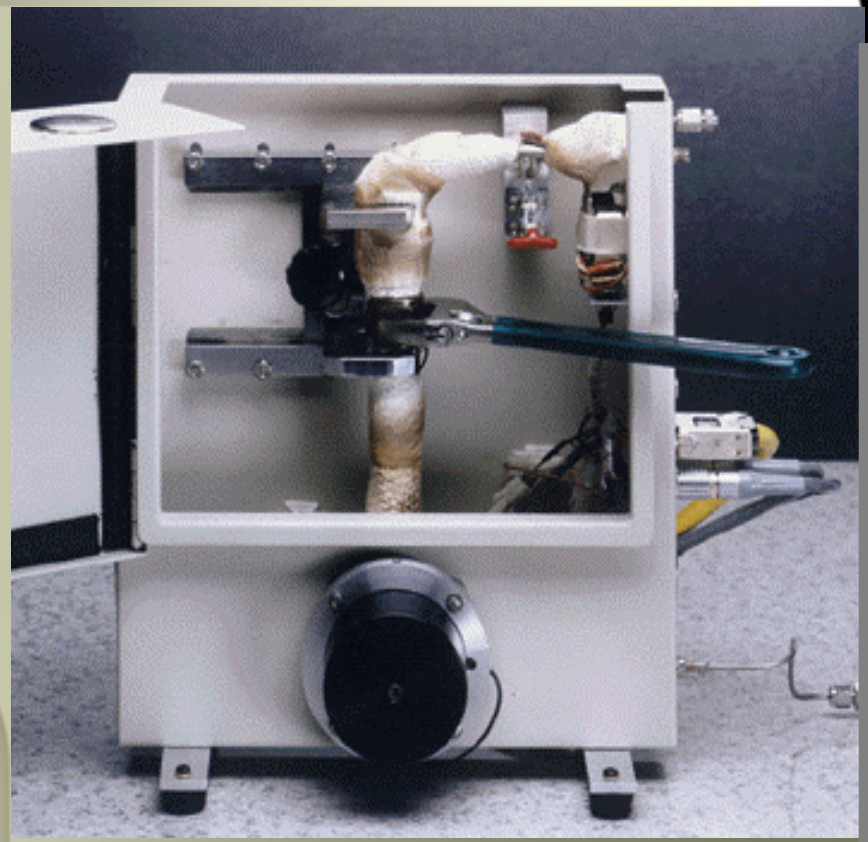


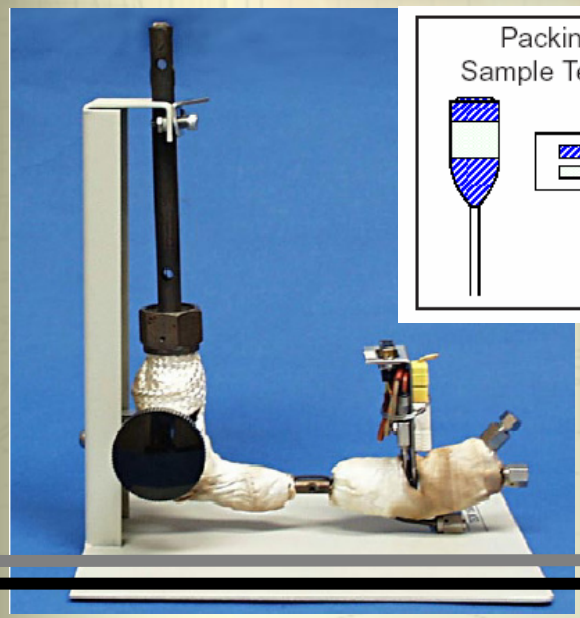
Mass sensitivity	Down to 1 μg
Time resolution	Down to 0.1 sec
Temperature range	rt to 700 ° C
Gas flow through	Up to 2 l/min
Pressure capability	to 50 Atm
Sample size	0.10 cc
Materials	Glass and SS

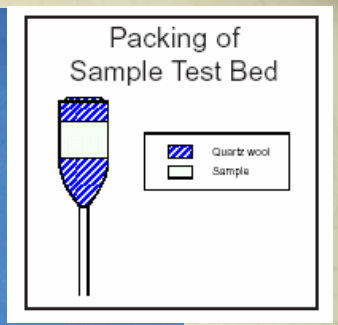
TEOM CATALYST LOADING



Rob Savinelli and Junming Sun







TEOM Experimental Setup

Reactor stabilizer acts as two wrenches during installation. (top left)
Sun Junming (above) connects the gas lines.
CP liquid transfer vessel. (top right)
Fitting at base of TEOM reactor. (left)
Pfeiffer mass spec. (right)

Acknowledgements

- Professor Susannah L. Scott
- Professor Bao Xinhe
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