

THE FIFTH BI-ANNUAL  
**Eisch Lectureship in  
Chemical Research B.  
Inorganic/Organo-  
metallic Chemistry**

Friday, April 8, 2016, 5:15 p.m.  
Academic Building A, Room G008

## Professor John J. Eisch

**J**ohn Joseph Eisch joined the Department of Chemistry at Binghamton University in 1972 as chair and professor of chemistry with the mandate of fostering the national reputation of its graduate teaching and research. Over the next six years as chair, he guided the recruiting of six senior and junior faculty with this goal in mind, while expanding his own research in organometallic chemistry to a yearly group of eight to 12 graduate and postdoctoral students with support from federal and industrial resources. In 1983 his composite achievements were recognized by his promotion to the SUNY-wide rank of distinguished professor of chemistry. Further recruiting, notably, during the chairs of Professors Eugene Stevens, Alistair Lees and currently Wayne Jones has expanded the scope of advanced research into areas of immediate importance, such as nano materials, homogeneous catalysis, analytical sensors, biological transformations and energy storage.

Professor Eisch's prior education and professional experience have consisted of receiving the BS degree in chemistry, summa cum laude, from Marquette University in 1952; earning the PhD degree in 1956, with Henry Gilman, at Iowa State University; and serving as Union Carbide Research Fellow with Karl Ziegler (Nobel Co-laureate in Chemistry, 1963) at the Max-Planck-Institut für Kohlenforschung, Mülheim, Germany (1956-57). After junior professional appointments at St. Louis University and at the University of Michigan, he became ordinary professor and department head at the Catholic University of America (1963-1972). He retired from his professorial career of 57 years in 2014, the latter 42 years of which being spent at the State University of New York at Binghamton.

Over the years, his research has involved the fruitful collaboration of more than 200 students as master's, doctoral, postdoctoral or baccalaureate associates. The results have been reported in more than 400 scientific publications, in some 280 invited lectures worldwide, in the monograph "The Chemistry of Organometallic Compounds" (Macmillan, 1967), and in the edited series, "Organometallic Syntheses" (four volumes, J.J. Eisch and R.B. King, authors and editors). He has been an industrial consultant on organometallic chemistry and an expert witness in several patent litigations on Ziegler-Natta polymerization catalysis. Recently he has published his reminiscences as a postdoctoral fellow with Karl Ziegler and as a young academic, in the invited review, "Fifty Years of Ziegler-Natta Polymerization: From Serendipity to Science. A Personal Account," in *Organometallics*, 2012, 31, 4917-4932, and in *Dalton Transactions* 2014 (DOI: 10.1039/c4dt010362) "Emergence of Electrophilic Aluminatation as the Counterpart of Established Nucleophilic Lithiation". The latter review was in honor of the eightieth birthday of his first doctoral graduate, William Kaska (Michigan, 1963). His most recent discovery with apparently carbanionic reactions is that they are NOT carbanionic in mechanism, but actually electron-transfer radical-anionic coupling reactions (*Eur. Org. Chem.*, 2015, 7384-7395).

# Organometallic Catalysis for Solar Fuels Formation and Storage



Solar, tidal and wind power could benefit both from fuel formation for vehicular transport applications and from energy storage to combat intermittency. Electrolysis of water to produce H<sub>2</sub> produces a potentially storable fuel but necessarily involves the more challenging water oxidation process at the counter-electrode. We have developed<sup>1</sup> a number of new water oxidation catalysts, based on Ir and Co. Hydrogen obtained from electric power by electrolysis is challenging to store. We have suggested<sup>2</sup> hydrogenation of N-heterocycles as a possible way to store hydrogen. The hydrogenation of quinolines by one of our iridium catalysts is found<sup>3</sup> to go by an unusual stepwise, outer-sphere path. Both Ir and Fe-based catalysts release H<sub>2</sub> from glycerol, a waste product in the biodiesel industry and at the same time forms the much more valuable byproduct, lactic acid.<sup>4</sup> The deactivation products from the Ir catalyst proved to be a series of tri- through hexanuclear clusters containing hydrides and N-heterocyclic carbenes as the only ligands. The H positions in the clusters were located from structural data, augmented by computational crystallography.<sup>5</sup>

1. *Nature Communications*, 2015, 5, 6469
2. *Energy Environ. Sci.*, 2008, 1, 134.
3. *JACS*, 2011, 133, 7547.
4. *Nature Chem.*, 2014, 5, 5084.
5. *Angew Chem.*, 2014, 53, 12808.

## Bob Crabtree

Professor of Chemistry  
Yale University

**R**obert (Bob) Crabtree was educated at New College, Oxford, with Malcolm Green, before earning his PhD with Joseph Chatt at Sussex University. He spent four years in Paris in Hugh Felkin's lab at the CNRS Natural Products Institute, headed at that time by Derek Barton. In 1977, he came to the U.S. as an assistant professor at Yale University, where he is now Whitehead Professor of Chemistry.

Most directly involved in organometallic chemistry, Crabtree's early work was on catalytic alkane C-H activation and functionalization chemistry via oxidative addition and mercury photosensitized pathways. Later, he extended this work to C-C and C-F bond activation. In hydride chemistry, he contributed to the development of dihydrogen complexes, developed the chemistry of M-H...H-(N,O) hydrogen bonding in inorganic chemistry and discovered halocarbon and HF complexation.

Early work on hydrogenation led to a homogeneous hydrogenation catalyst with very useful properties including the ability to reduce tri- and tetrasubstituted C=C bonds, a problem of considerable interest for which no other catalyst type has proved as satisfactory. The catalyst also gives an extremely high degree of control over the diastereoselectivity because the catalyst coordinates to a variety of pre-existing functional groups on the substrate and adds the hydrogen from that side of

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the molecule. It also gives very fast H/D or H/T isotope exchange; the H/T exchange has found extensive use in the pharmaceutical industry where predictable incorporation of isotope occurs with very high radiochemical yield.

Crabtree recently developed the concept of "virtual hydrogen storage," now funded in an Energy Frontier Research Centers (EFRC) headed by GE Global Research. A member of three EFRCs, he is also a member of the Yale Solar Group working to develop a photoelectrochemical water splitting cell.

A member of the Royal Society of Chemistry, the American Chemical Society and the American Academy of Arts and Sciences, Crabtree has been recognized with numerous honors including being named an Alfred P. Sloan Foundation Fellow and Dreyfus Teacher-Scholar. He has received the ACS and Royal Society of Chemistry Awards for organometallic chemistry and has been chair of the Division of Inorganic Chemistry of ACS.

Author of the standard textbook, *The Organometallic Chemistry of the Transition Metals*, 6th edition, Wiley, N.Y., 2014, Crabtree was editor-in-chief of the *Comprehensive Organometallic Chemistry-III* (with DMP Mingos) and the *Encyclopedia of Inorganic Chemistry* (2<sup>nd</sup> ed). He has published approximately 600 papers in learned journals, with an *h*-index of 99.

## Previous Lectureship Recipients

2012

**Stephen L. Buchwald**  
MIT

"Palladium-Catalyzed Carbon-Nitrogen and Carbon-Carbon Bond-Forming Reactions: Progress, Applications and Mechanistic Studies"

2013

**David W. C. MacMillan**  
Princeton University

"The Use of Photoredox Catalysis in New Organic Bond Forming Reactions"

2014

**Brian M. Stoltz**  
California Institute of Technology

"Complex Natural Products as a Driving Force for Discovery in Organic Chemistry"

2015

**Eric N. Jacobsen**  
Harvard University

"Anion-Binding Catalysis"