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Related Links

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Education **Research Interests** **Biography** **Awards** **Publications**

Education:

University of Innsbruck, Austria
PhD Chemistry ’78
BS Chemistry ’75

Research Interests: ^top

Our research program is focused on fundamental and applied research problems in heterogeneous catalysis, sensors, and energy storage materials. A major theme is the development of correlations between surface structure of materials and their reactivity. The laboratories are equipped with comprehensive catalyst and materials characterization facilities.

In the area of heterogeneous catalysis, we focus on correlations between the catalyst structure and composition and catalytic function in reactions of industrial importance. Principles of nucleation, clustering, and growth of small particles on support materials are under investigation, with emphasis on bimetallic catalyst systems and oxide catalysts. Of particular interest are geometric and electronic interactions between catalyst components as a means to modify catalytic activity and selectivity. A major thrust of our research efforts is the characterization of supported catalysts by analytical and high-resolution electron microscopy. The microstructural characterization results are then brought into context with X-ray diffraction, atomic absorption, neutron activation analysis, gas chemisorption and X-ray photoelectron spectroscopy data. In-situ spectroscopic techniques such as Fourier-Transform infrared spectroscopy are utilized to monitor adsorbed surface species under reaction conditions. These characterization data are then used to interpret kinetic results for hydrogen or oxygen transfer reactions obtained in flow reactors. Current catalysis projects include autothermal reforming of hydrocarbons, direct reforming solid oxide fuel cell catalysts, automotive emission control catalysis, Fischer-Tropsch catalysis, partial oxidation of hydrocarbons, photocatalytic oxidation and water splitting, and biomass conversion.

In the area of sensors, our group has developed microelectronic gas sensors for a wide range of important applications, from monitoring the purity of microelectronic processing gases to environmental sensing and automotive exhaust gas sensing and diesel particulate sensing. Chemical species are detected on the basis of several principles, including gas adsorption-induced resistance and work function changes.

In the energy storage area, we work on synthesis and characterization of battery electrode materials, with special focus on prototyping of multivalent intercalation cathode materials.

Biography: ^top

Society Memberships

American Chemical Society (ACS)
American Institute of Chemical Engineers (AICHE)
Michigan Catalysis Society (MCS)

Positions Held at U-M

James and Judith Street Professor of Chemical Engineering (2009-present)
Director, Researching Fresh Solutions to the Energy/Water/Food Challenge in Resource-Constrained Environments (REFRESCH) (2013 – present)

Director, Electron Microbeam Analysis Laboratory, (2013-2015)
Interim Director, Energy Institute (2011-2012)
Professor, Department of Chemical Engineering (1990-present)
Associate Director, Electron Microbeam Analysis Laboratory (1986-2000)
Associate Professor, Department of Chemical Engineering (1984-1990)
Assistant Professor, Department of Chemical Engineering (1980-1984)
Engineering Research Assistant, Department of Chemical Engineering (1979-1980)
Postdoctoral Scholar, Department of Chemical Engineering (1978-1979)

Positions Held Elsewhere

Visiting Professor, University of Innsbruck, Austria, (1987-1988)
Visiting Professor, Technical University, Vienna Austria, (1987)
Guest Professor, Tianjin University, Tianjin, China (2011-2013)

Courses Taught

ChE 230 – Thermodynamics I
ChE 342 – Heat and Mass Transfer
ChE 344 – Reaction Engineering and Design
ChE 460 – Chemical Engineering Laboratory II
ChE 470 – Colloids and Interfaces
ChE 485 – Chemical Engineering Process Economics
ChE 486 – Chemical Process Simulation and Design I
ChE 487 – Chemical Process Simulation and Design
ChE 496 – Selected Topics: Hydrogen Technology I
ChE 542 – Intermediate Transport Phenomena
ChE 628 – Industrial Catalysis
ChE 696 – Selected Topics: Chemical Sensors
ChE 696 – Selected Topics: Fuel Cells and Fuel Processors
ChE 696 – Selected Topics: Hydrogen Technology
ChE 696 – Selected Topics: Fossil and Renewable Fuels
ChE 697 – Problems in Chemical Engineering: Thin Films and Catalysis

Awards: ^top

Fellow, American Institute of Chemical Engineers, 2017
U-M Chemical Engineering Department Excellence Award, 2005
College of Engineering Excellence in Service Award, 1996
Giuseppe Parravano Award for Excellence in Catalysis Research, 1994
Research Excellence Award, College of Engineering, U of M, 1989
Class of 1938 E Distinguished Service Award, U of M, 1986