

# Sustainable Chemistry through Catalysis

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## Overview

To meet improved living standards of earth's growing population, a constant supply of chemical products must be maintained. These chemicals need to be accessed in a simple and energy-efficient manner utilizing cheap and abundant natural sources with minimal chemical waste. Catalysis is the key technology to convert challenging substrates to useful chemicals. This course covers the fundamental and applied aspects of homogeneous catalysis. A specific focus will be directed on catalysis for oxidative transformations, and the ensuing aspects related to ligand design. Underlying design principles for ligands to operate under specific conditions will be discussed as well applications and perspectives, for example towards artificial photosynthesis and water splitting.

## Objectives

- (1) Describe the capacity of catalysis; develop a critical reading of literature data.
- (2) Understand sustainability on a comprehensive level.
- (3) Derive the overall reactions of hydrogen evolution, oxygen evolution, and hydrogen transfer processes.
- (4) Assess catalyst performance in terms of efficiency, robustness, and activity.
- (5) Interpret heterogeneous and homogeneous catalysis from collective observables.
- (6) Elaborate the distinct key bond forming steps in oxygen evolution and CH bond activation, and the implications on ligand/catalyst design.
- (7) Construct plausible catalytic cycles for key processes discussed in the course.
- (8) Apply first principles for catalyst design for target reactions that improve sustainability.

<b>Modules</b>	<b>March 21 to March 24, 2017</b>
<b>You Should Attend If...</b>	<ul style="list-style-type: none"><li>▪ You are a chemist interested in homogeneous catalysis.</li><li>▪ You are a material scientist interested in catalytic materials and energy conversion.</li><li>▪ You are a chemical engineer interested in water splitting devices.</li><li>▪ You are doing PhD in Inorg. Chem. in the area of catalysis and/or bio-inorganic chemistry</li></ul>
<b>Fees</b>	The participation fees for taking the course is as follows: <b>Participants from abroad : US \$500</b> <b>Industry/ Research Organizations: INR 10000</b> <b>Academic Institutions: INR 1000</b> The above fee include all instructional materials, computer use for tutorials and assignments, laboratory equipment usage charges, 24 hr free internet facility. The participants will be provided with accommodation on payment basis.

## The Faculty



**Prof. Martin Albrecht** studied chemistry at the University of Bern (Switzerland) and obtained a M.Sc. degree in early 1996. He then moved to the Netherlands and began his doctoral study under the guidance of Prof. Gerard van Koten at Utrecht University. His dissertation research focused on the synthesis and application of pincer complexes in catalysis, molecular switches, and sensors. After receiving a Ph.D. degree in chemistry in November 2000, he became a postdoctoral research fellow in the group of Prof. Robert H. Crabtree at Yale University. At Yale, he worked on the development of N-heterocyclic carbenes as ligands for transition metal catalysis. He then moved to Ciba SC in Basel, Switzerland and was appointed as postdoctoral research to launch the companies nanoparticle business. In 2003, he was awarded an Alfred Werner Assistant Professorship and started his independent research program at the University of Fribourg, Switzerland. In 2009, he moved to University College Dublin, Ireland as a full professor of inorganic chemistry. Recently, he accepted a call from his alma mater and relocated back to the University of Bern in Switzerland, where he is now full professor of chemistry. His research aims at developing new ligands and new catalytic systems for challenging bond activation catalysis.



**Dr. Sabuj Kundu** received MSc (2002) degree from IIT Bombay. He worked with Prof. Alan S Goldman for his PhD (2009) at Rutgers, The State University of New Jersey, USA. Then he worked with Prof. William D. Jones at University of Rochester, Rochester, NY (2009-11) and Prof. Maurice Brookhart at University of North Carolina at Chapel Hill (2011-13) as postdoctoral fellow. He joined IIT Kanpur as an assistant professor on 2013 and he is a recipient of DST-INSPIRE fellowship, India. His group is focused on various aspects of homogeneous and heterogeneous catalysis for sustainable chemical transformations including alternative energy production.



**Professor J. K. Bera** received his M. Sc. from the University of Kalyani in 1993 and his Ph. D. from the Indian Institute of Science in 1999. After a couple of postdoctoral stints at Purdue University and at Texas A&M University, he joined the faculty at IIT Kanpur in 2003. He is presently Satish Chandra Agarwal Chair Professor and associate Dean of faculty affairs. He recently received DAE-SRC outstanding investigator award. He is also the recipient of the Ramanna fellowship and the SwarnaJayanti fellowship from DST, India, and has received the CRSI bronze medal for the year 2011. He is the fellow of the National Academy of Sciences (FNASc) and Indian Academy of Sciences (FASc). Bera's research interests span synthetic, structural and mechanistic organometallic chemistry. Recent efforts are directed toward bifunctional activation of small and abundant molecules and their catalytic transformations to useful and value-added chemicals.

## Course Coordinators

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