Department of Chemical & Biomolecular Engineering

CCST Center for Catalytic Science & Technology

proudly presents the

# George C. A. Schuit Lecture

## Nenad Markovic

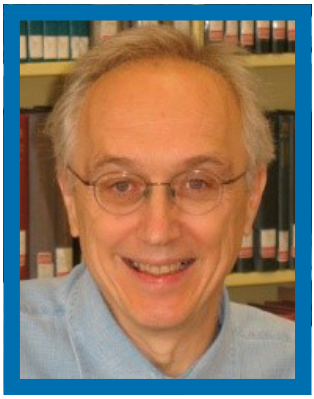
Argonne Distinguished Fellow

Argonne National Laboratory

# "The Renaissance of Electrochemistry"

Friday, November 17, 2017 at 10:00 AM
102 Colburn Laboratory
150 Academy Street • Newark, Delaware

UNIVERSITY *of* DELAWARE



Nenad M. Markovic is a Distinguished Fellow, Group Leader, and Chief Scientist for the Joint Center for Energy Storage Research at Argonne National Laboratory. Prior to joining ANL he was a Staff Scientist and Principal Investigator at Lawrence Berkeley National Laboratory from 1991-2005. He received his BSc, Ms.D. and Ph.D. degrees all from the University of Belgrade, and served as Group Leader at the Institute of Electrochemistry, University of Belgrade from 1985 to 1991. He is one of the pioneers of the development of electrocatalyst materials for fuel cells and electrolyzers. More recently he has advanced a surface science-based approach to advance lithium ion battery technologies. He is the author or co-author of over 270 papers and fifteen US patents. He has also received many awards, including the 2016 Wilhelm Manchot Research Professorship (Technical University of Munich) and the 2013 Faraday Medal Award.

Dr. Markoic's major research interest is understanding surface processes at the electrified metal-solution interfaces. Utilizing ex-situ (AES, LEED, UPS, XPS) and in-situ (SXS, STM/AFM) surface sensitive probes in combination with vibrational spectroscopy (FTIR, ATR) and classical electrochemical methods he established relations between the microscopic surface atomic/electronic structures of mono-metallic and multi-metallic single crystal surfaces and the macroscopic kinetic rates of (electro)chemical reactions. The knowledge obtained by studying model single crystal surfaces he used for both understanding the activity pattern of metal nanoparticles employed in energy conversion and storage systems as well as for finding relationships between the reaction rate, selectivity and stability with the characteristic dimension of a metallic catalysts. He is the author of more then 190 papers in the field of catalysis and surface electrochemistry.

# "The Renaissance of Electrochemistry"

Developing and deploying renewable energy technologies will require the application of knowledge, concepts, and tools from a variety of fields including chemistry, materials science, physics and, in particular, electrochemistry. Electrochemistry is, in the broadest sense, the study of relationships between the transformation of electrical energy in chemical bonds and, in the reverse process, the energy stored in chemical bonds back to electrons that can power electrochemical energy storage and conversion systems Central to this presentation will be to introduce - at atomic and molecular levels - electrochemical interfaces in aqueous and organic environments and to argue that we are witnessing the renaissance of electrochemistry. Key correlations will be discussed, including structure-function relationships, functional links between covalent and non-covalent interactions, the role of pH values, and key descriptors that control functional links between activity, stability, sensitivity and conductivity of the interface. Fundamental understanding of critical electrochemical processes at interfaces will provide ample opportunities (and challenges) to further improve the current landscape of sustainable energy production and utilization. We will conclude by asking us what we don't know but we would like to know about electrochemical interfaces.

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# About the Lectureship

The Center for Catalytic Science and Technology (CCST) was established in 1977 to formalize and strengthen the vigorous research in catalysis, which had developed at Delaware in the preceding decade. The goal for the CCST was to establish a multidisciplinary organization dedicated to advancing the science and engineering of catalysis by conducting fundamental research motivated by technological need, integrating the key disciplines of chemistry, surface science, and chemical engineering, especially chemical reaction engineering. During its first decade, the CCST faculty pioneered efforts to develop and apply new spectroscopic techniques such as EXAFS and NMR to the characterization of catalysts.

George C. A. Schuit was a key figure in founding the Center with a dedicated group including James R. Katzer, Bruce C. Gates, Alvin B. Stiles, Arthur B. Metzner and, later, Kenneth B. Bischoff. Dr. Schuit received his PhD from the University of Leiden in 1938 and then worked at Shell Research in Amsterdam. He joined Eindhoven University in 1961 before coming to the University of Delaware. He played a crucial role in the development of the CCST and his concept of academic catalysis research influenced the faculty, helped to set research philosophy, and provided much of the scientific and intellectual leadership during the Center's formative years. He was well known for his incisive fundamental investigations of complex industrial catalysts, including mixed metal oxides, supported metals, and supported metal sulfides. He was a pioneer in the application of solid-state chemistry in catalysis research and in the application of spectroscopic techniques in concert with chemisorption and chemical reaction probes for structural elucidation of catalysts.

The Center for Catalytic Science and Technology Annual Research Review is held each Fall. The G. C. A. Schuit Symposium Series was established in 1985 to honor Dr. Schuit's many years of service as a Research Professor and his influence in the formation of CCST.

# History of Lecturers

- G. Ertl, Institute of Physical Chemistry, University of Munich, Germany
- J. M. Thomas, F. R. S., Royal Institution of Great Britain
- George M. Whitesides, Harvard University
- George Parshall, E. I. du Pont de Nemours and Company
- James P. Collman, Stanford University
- Robert H. Crabtree, Yale University
- Roel Prins, Federal Institute of Technology, Zurich
- Mark H. Wrighton, Massachusetts Institute of Technology
- Yashuiro Iwasawa, University of Tokyo, Japan
- T. Michael Duncan, AT&T Bell Laboratories
- John T. Yates, Jr., University of Pittsburgh
- Wolfgang M. H. Sachtler, Northwestern University
- James Wei, Massachusetts Institute of Technology
- John H. Sinfelt, Exxon R&E Company
- M. Albert Vannice, Pennsylvania State University
- Gary L. Haller, Yale University
- Robert J. Madix, Stanford University
- Russell S. Drago, University of Florida
- James A. Dumesic, University of Wisconsin
- Michael C. Zerner, University of Florida
- Preetinder Virk, Massachusetts Institute of Technology
- James E. Lyons, Sun Refining and Marketing Company
- Mark Davis, California Institute of Technology
- Arvind Varma, University of Notre Dame
- Wolfgang F. Holderich , University of Aachen, Germany
- Jack Lunsford, Texas A&M University
- Lanny D. Schmidt, University of Minnesota
- James R. Katzer, ExxonMobil Research and Engineering Co.
- Jens K. Norskov, Director, Center for Atomic-scale Materials Physics, Denmark
- Michael Tsapatsis, University of Minnesota
- Shimshon Gottesfeld, CellEra Inc.
- Hubert A. Gasteiger, Technische Universität München