

Past Nowinski Lecturers

- 2009 Zhigang Suo, Harvard University
- 2008 Yonggang Huang, Northwestern University
- 2008 Donald E. Ingber, Harvard Medical School
- 2007 Huajian Gao, Brown University
- 2006 Mary C. Boyce, Massachusetts Institute of Technology
- 2005 Tsu-Wei Chou, University of Delaware
- 2004 L. Ben Freund, Brown University
- 2002 Ali H. Nayfeh, Virginia Polytechnic Institute and State University
- 2001 Anthony G. Evans, Princeton University
- 2000 R. Bruce Martin, UC Davis Medical Center
- 1998 James R. Rice, Harvard University
- 1997 Cornelius O. Horgan, University of Virginia
- 1996 J. D. Achenbach, Northwestern University
- 1995 Michael M. Carroll, Rice University
- 1994 John Dundurs, Northwestern University
- 1993 Paul M. Naghdi, University of California at Berkeley
- 1992 James K. Knowles, California Institute of Technology
- 1991 Eric Reissner, University of California—San Diego
- 1990 Fazil Erdogan, Lehigh University
- 1989 Millard F. Beatty, University of Kentucky
- 1988 Mohsen Shahinpoor, University of New Mexico
- 1987 J. L. Ericksen, University of Minnesota
- 1986 Earl Dowell, Duke University
- 1985 C. C. Wang, Rice University
- 1984 Jerzy L. Nowinski, University of Delaware
- 1993 Roland S. Rivlin, Lehigh University
- 1982 Johannes Weertman, Northwestern University
- 1981 D. C. Drucker, University of Illinois
- 1980 Stephen H. Crandall, Massachusetts Institute of Technology
- 1979 Aris Phillips, Yale University
- 1978 Martin Goland, Southwest Research Institute
- 1977 Eli Sternberg, California Institute of Technology
- 1976 A. Cemal Eringen, Princeton University
- 1975 Clifford A. Truesdell, The Johns Hopkins University



College of Engineering

DEPARTMENT OF MECHANICAL
ENGINEERING

Betty Bonavita
Department of Mechanical Engineering
(302) 831-6975
bonavita@udel.edu
www.me.udel.edu

The **Department of Mechanical Engineering**

is proud to announce the

Jerzy L. Nowinski
Distinguished Lecture



**“Models for lithium-ion battery
performance and damage”**

Presented by Dr. Robert M. McMeeking

10:00 AM • Friday • March 4 • 2011

205 Gore Hall

Refreshments will be served



College of Engineering

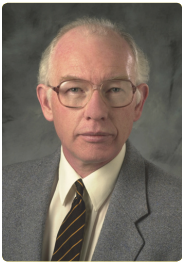
DEPARTMENT OF MECHANICAL
ENGINEERING

"Models for lithium-ion battery performance and damage"

Presented by Robert M. McMeeking
10:00 A.M. • Friday • March 4 • 2011 • 205 Gore Hall
Refreshments will be served

LECTURER BIOGRAPHY

Robert M. McMeeking



Robert M. McMeeking earned a B.Sc. (with 1st Class Honors) at the University of Glasgow, Scotland in 1972, finishing first in his class of mechanical engineers. In 1976 he completed his Ph.D. in solid mechanics at Brown University under the supervision of Professor James R. Rice. He was at Stanford University for 2 years as a post-doctoral associate, and then was appointed assistant professor at the

University of Illinois at Urbana-Champaign, in the Theoretical and Applied Mechanics Department. McMeeking moved to UCSB in 1985 as Professor of Materials and of Mechanical Engineering. He was Chair of the Department of Mechanical Engineering at UCSB in 1992-1995 and again during 1999-2003. He has published over 230 scientific papers on a variety of subjects in engineering science and solid mechanics. In 1998 he was advanced to Fellow grade in the American Society of Mechanical Engineers and in 2002 was recognized by the Institute for Scientific Information as a Highly Cited Researcher in the fields of Materials Science and Engineering. McMeeking was elected to the National Academy of Engineering in 2005, and given the Brown Engineering Alumni Medal by Brown University in 2007. He is currently Editor of the Journal of Applied Mechanics for the term 2002-2012. In addition to his appointment at UCSB, Dr. McMeeking is Sixth Century Professor of Engineering Materials (part-time) at the University of Aberdeen, Scotland, Visiting Professor of Materials Engineering at the University of the Saarland, Germany, and External Member of the Leibniz Institute for New Materials, Saarbruecken.

ABSTRACT SUMMARY

Models for lithium-ion battery performance and damage

Models are developed for the transport of Li ions in the electrolyte of lithium ion batteries, their diffusion through storage electrode particles, and their kinetics through the surface of the particles between the electrolyte and the particles. As a consequence of the Li ion intercalating in the storage particles, their lattice swells, leading to elastic stress when the concentration of Li ions in the particles is not uniform. The models of transport are based on standard concepts for multi-component diffusion in liquids and solids, but are not restricted to dilute solutions, or to small changes in the concentration of the diffusing species. In addition, phase changes are permitted during mass transport as the concentration of lithium varies from the almost depleted state of the storage particle to one where the material is saturated with its ions. The elastic swelling and shrinkage may involve very large dilatations, which are allowed for in the formulation of the model. Thus, the models are suitable for storage particle, where the amount of Li can vary by large amounts depending on the state of charge, for staging as observed in the storage process in graphite, for the enormous swelling that takes place when silicon is used for storage, and for electrolytes in which the concentration of Li ions is high. The model is used to compute the processes of charging and discharging the battery to assess the parameters that influence the development of stress in the storage particles, and to deduce the likelihood of fracture of the storage particle material. The objective is to assess designs of porous electrode microstructures that permit rapid charging and discharging, but obviate the likelihood of fracture and other mechanical damage that limit the performance and reliability of the battery.

The Jerzy L. Nowinski Lectureship



The Nowinski Lecture Series honors Jerzy L. Nowinski, Professor Emeritus in Mechanical Engineering at the University of Delaware, for his contributions to the field of Applied Mechanics. Each year, one outstanding individual in Applied Mechanics is invited to present a lecture in the series. Dr. Jerzy L. Nowinski was the H. Fletcher Brown Professor in the Department of Mechanical Engineering

and subsequently the Department of Mechanical and Aerospace Engineering at the University of Delaware from 1961 to 1973. During that period in which the Department size increased significantly he was the academic leader and senior member of the Department. Upon his retirement, the Department initiated the Nowinski Lecture, which has been given each year as part of the Mechanical Engineering seminar series, which is the oldest continuous seminar series at the University, having been established in 1975. The list of Nowinski lecturers appears on a plaque in the departmental office and reads like a Who's Who of Applied Mechanics. In 1999, a full-day Nowinski Symposium was also held to honor Dr. Nowinski on his 94th birthday. Dr. Jerzy L. Nowinski received his Master of Civil Engineering and Doctor of Technical Sciences from the Polytechnic Institute of Warsaw. Prior to World War II, he was a senior researcher at the Polish Aeronautical Institute and continued working there after the War until 1950. Before coming to the United States in 1957, he was the Extraordinary Professor in the Mathematical Institute of the Polish Academy of Sciences, Research Professor in the Institute of Fundamental Problems of Technology, and the Editor-in-Chief of three journals devoted to applied mechanics and published by the Academy. In Poland he was awarded an Officer Cross of Polonia Restituta, Gold Medal of Merit, Government Scientific Award, Silver and Gold Awards for the Reconstruction of Warsaw, and the Huber Scientific Prize. After coming to the United States, he was a visiting lecturer at Johns Hopkins University in 1957-1958, a professor at the University of Wisconsin, and a professor of Applied Mechanics at the University of Texas in 1960-1961.