The Chemical and Biological Engineering Department of the
University at Buffalo School of Engineering and Applied Sciences
Is Proud to Announce

The 2010 Eli Ruckenstein Lecture

"Nanoscale Process Systems Engineering: Towards Molecular Factories, Synthetic Cells, and Adaptive Devices"

George Stephanopoulos

Arthur D. Little Professor

Department of
Chemical Engineering

Massachusetts Institute
of Technology

Thursday, April 29, 2010
10:45 a.m.

Screening Room
First floor, Center for the Arts
UB Amherst Campus

Reception to follow

School of Engineering and Applied Sciences
University at Buffalo *The State University of New York*

About Eli Ruckenstein:

Eli Ruckenstein, SUNY Distinguished Professor, has been on the faculty of the University at Buffalo for nearly forty years. Over this time, his prolific and imaginative research has advanced almost every area of interest to chemical engineering. Ruckenstein spent his formative years behind the Iron Curtain, in Romania, where — with a combination of native intellect, genuine scientific curiosity, and sheer strength of will — he prepared himself for a lifetime of achievement in engineering and science. In Romania his work quickly gained international recognition, and he escaped to the West in 1969, joining UB in 1973.

Eli Ruckenstein has received countless honors paying tribute to work across many fields of research, including the Alpha Chi Sigma Award (for his work in transport phenomena), the Kendall Award (colloids), the Langmuir Lecture (polymers), the Murphree and Walker Awards (catalysis), and the Humboldt Award (surfactants). These contributions and more were further recognized with the National Medal of Science, given to him in a White House ceremony in 1999. Ruckenstein was elected to the National Academy of Engineering in 1990, and he received the Founders Award from the Academy in 2004. The American Institute of Chemical Engineers honored him with their Founders Award, and has formally designated him as one of Fifty Eminent Chemical Engineers of the Foundation Age.

The Ruckenstein Lecture Series

is supported by the Ruckenstein Fund, a new endowment with an ongoing campaign. Funds generated from this endowment will be used to support the Ruckenstein Lecture Series and provide resources to improve teaching and research laboratories in the Department.

Previous Lecturers

2009 Rakesh K. Jain, Harvard Medical School and Massachusetts General Hospital

www.cbe.buffalo.edu

The UB Department of Chemical and Biological Engineering

offers a world-class undergraduate education while pursuing integrative research and graduate training at the frontiers of chemical engineering, in the main areas of nanoscale science and engineering; computational science and engineering; and biochemical and biomedical engineering.

The Department was founded in 1961 and is among the youngest in the Nation. From the start its founders inculcated it with a deep respect for scholarship, and as a consequence the Department quickly grew to the national prominence that it continues to enjoy today. The Department is now undergoing a second phase of growth. Since 2006 faculty size has increased from 13 to 20, and our ranks now include three members of the National Academy of Engineering. Visit: www.cbe.buffalo.edu.

Nanoscale Process Systems Engineering: Towards Molecular Factories, Synthetic Cells, and Adaptive Devices

George Stephanopoulos

Arthur D. Little Professor
Department of Chemical Engineering
Massachusetts Institute of Technology

Abstract:

Research in nanoscale science and engineering has been primarily directed towards the design and manufacturing of (1) *materials with passive nanostructures* (such as coatings), and (2) *active devices with nanostructured materials* (such as drug delivery systems). Research on the design, fabrication and operation of integrated "nanoscale factories" is lagging seriously behind. It is progress at this frontier that will enable the research visions of molecular factories, synthetic cells and adaptive devices to become reality.

My presentation will be composed of two parts. In the first part I will describe the essential systems engineering questions that need to be addressed before we are able to design, fabricate and operate processes at the nanoscale. These questions define my research interests and include: (a) synthesis of reaction networks; (b) fabrication of structures with desired geometries; and (c) design of self-regulating dynamic systems. In the second part I will discuss in more detail our research work on (b), *i.e.*, the controlled formation of self-assembled nanostructures with desired non-periodic geometric features, and the design principles and methodologies guiding such a formation: a hybrid top-down formation of physical domains with externally-imposed controls, and bottom-up generation of the desired structure through the guided self-assembly of the nanoscale particles.

About George Stephanopoulos:

George Stephanopoulos' research and teaching interests have covered many aspects of Process Systems Engineering, *e.g.*, design, control, and optimization, over a variety of systems including the following: continuous and batch chemical processes; networks of chemical or biochemical reactions; integrated manufacturing systems within the scope of a national economy or corporate business; product design; and process systems engineering for integrated nanoscale processes (his current focus and love).

Over the years Stephanopoulos has mentored more than 60 doctoral and postdoctoral students, with 20 of them in academic positions around the world, and more than 30 M.S. students. His recent academic family tree includes nearly 500 members worldwide. George has co-authored 7 books and co-edited 8, and he is co-author to more than 210 papers.

George is a member of the National Academy of Engineering, a Foreign Member of the Russian Academy of Technological Sciences, and recipient of an Honorary D.Sc. from McMaster University. The American Institute of Chemical Engineers has selected him as a Fellow and the 2003 Institute Lecturer; honored him with the Walker and Colburn Awards, and the 1993 Computing in Chemical Engineering Award, of its CAST Division. In 2009 he received the Ragazzini Award of American Automatic Control Council for his work on education in control theory. He has also received the C. McGraw Award for Research from ASEE and a Dreyfus Teacher-Scholar Award. He has delivered more than 20 honorary named lectures. During the period 2000-02, he took a leave of absence from MIT and was appointed Chief Technology Officer and Managing Executive Officer of Mitsubishi Chemical Corporation. In 2002 he was appointed Member of the Board supervising the group's R&D activities, a position he held until 2005.

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