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The 36th Annual Harry G. Fair Memorial Lecture in Chemical Engineering

Thursday, February 25, 2010
Seminar – 3:00 P.M.
M-204 Sarkeys Energy Center
100 East Boyd
University of Oklahoma
Norman, Oklahoma

Coffee and refreshments will be served prior to the lecture.

Accommodations on the basis of disabilities are available by calling (405) 325-5811.

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Harry G. Fair Memorial Lecturers

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College of Engineering
University of Oklahoma
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Norman, Oklahoma 73019-1004

The 36th Annual
Harry G. Fair
Memorial Lecture in Chemical Engineering
2010

Juan J. de Pablo
Chemical and Biological Engineering
University of Wisconsin - Madison
Madison, Wisconsin, USA

Driven Assembly at the Nanoscale, and its Application to Nanofabrication
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Juan J. de Pablo
Chemical and Biological Engineering
University of Wisconsin - Madison
Madison, Wisconsin, USA

There is considerable interest in devising nanofabrication strategies that rely on the molecular self-assembly of complex fluids and materials. Our efforts over the past several years have been focused on conceiving strategies to drive and direct that self assembly, largely by developing multiscale modeling models and methods capable of predicting the structure and properties of complex fluids and materials under external fields, including confinement, electric fields, or flow fields. These models and methods can vary considerably in nature and level of resolution, depending on the system and issues of interest. In this presentation I will discuss three modeling approaches, along with their usefulness and limitations, in the context of three distinct nanofabrication platforms. The first is concerned with the elongation and presentation of long DNA molecules in nanofluidic channels. A coarse grain model, that includes fluctuating hydrodynamic interactions, has been used to design a gene mapping device and to interpret experimental data pertaining to the structure and dynamics of confined chromosome-length DNA. The validity of our results is established by comparison to experiments, to results of detailed molecular dynamics simulations, and to results from coarse grain Lattice-Boltzmann simulations. The second application is concerned with the study of liquid-crystal based biosensors. A multiscale model has been used to design liquid-crystal based devices in which nanoscale particles self assemble into highly regular structures, including chains, upon exposure to proteins or virions. As discussed in this presentation, the model can be used to explain the defects and transmission images that arise in laboratory experiments. The model is validated by comparison to results from experiments and atomistic simulations. The third application is concerned with the formation of ordered, defect-free block copolymer structures on nanopatterned substrates. A new mesoscopic formalism has been developed to describe the structure and dynamics of block copolymer blends and composites, and we use it to explain the effects of surfaces and different types of confining walls on the free energy (and the concomitant stability) of a variety of morphologies of interest for lithographic fabrication. The results of these calculations are consistent with experimental observations, and also with those of detailed many-body simulations.

Juan J. de Pablo Biography

Juan de Pablo is the Howard Curler Distinguished Professor of Chemical Engineering. He is the Director of the NSF-funded Materials Research Science and Engineering Center (MRSEC) on Nanostructured Interfaces at the University of Wisconsin, Madison. Prior to assuming the Directorship of the MRSEC, Prof. de Pablo was Director of the University of Wisconsin’s Center for Nanotechnology (CNTECH). Prof. de Pablo received his PhD from the University of California, Berkeley. He holds a BS degree in chemical engineering from the National University of Mexico. He specializes in the modeling and characterization of complex fluids, macromolecular solutions and polymeric materials for advanced applications. He is the author of over 300 publications, a textbook, and several patents. He has received numerous awards, including a PECASE award from the National Science Foundation, a Teacher-Scholar Award from the Dreyfus Foundation, and several awards for outstanding teaching. He is a fellow of the American Physical Society, and he currently serves as Associate Editor of Physical Review Letters, Journal of Physics Condensed Matter, and Journal of Materials Research.

Harry G. Fair

Each year, a special lecture is given in memory of Harry G. Fair, an outstanding OU alumnus. Fair was born in Okmulgee, Oklahoma, on June 3, 1916, and earned his bachelor of science degree in chemical engineering in 1939. He joined Phillips Petroleum Co. in 1939 and worked his way up to vice president for supply and transportation, with responsibility for worldwide exchange of crude oil and all transportation facilities. In 1966, Fair joined M.W. Kellogg Co. as executive vice president in charge of all engineering activities. He was named executive vice president of Coastal States Gas Corp. in 1971, a post he held until his death on July 27, 1974. A member of a number of professional societies and a licensed professional engineer, Fair was active in service to society and his alma mater.

This lecture is made possible by the Harry G. Fair Memorial Fund established by his widow, Jane Swift Fair. Arrangements for the lecture are made by the School of Chemical, Biological and Materials Engineering in OU’s College of Engineering.