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Department of Chemistry

Moscowitz Memorial Lectureship

9:45 a.m. Thursday, May 7, 2015 • 331 Smith Hall

Professor

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Self-Energy Effects of Salt Ions on Phase Behavior and Interfacial Properties

http://www.che.caltech.edu/faculty/wang_z/index.html

Abstract

Ions are essential in physical chemistry, colloidal science, electrochemistry, biology and many other areas of science and engineering. While their role is commonly described in terms of screening and translational entropy, many phenomena, ranging from some classical experimental observations made many decades ago to some new systems of current interest, cannot be explained, even qualitatively, by these concepts. A key effect that is often ignored or inadequately treated in the main literature on electrolytes and polyelectrolytes is the self-energy of the ions. In this talk, I will discuss several self-energy effects in macromolecular and interfacial systems. First, we show that the preferential solvation energy of the ions provides a significant driving force for phase separation. This concept is used to develop a theory to explain the dramatic shift in the order-disorder transition temperature in PEO-PS diblock copolymers upon the addition of salt. Second, we show that the dielectric contrast between the polymer backbone and the solvent significantly affects the conformation and charge condensation in dilute polyelectrolyte solutions. Third, we show that the image force has qualitative effects on the double layer structure and forces, such as like charge attraction and charge inversion. Finally, we present a simple model for understanding the specific ion effects in the interfacial activity for air/water and oil/water interfaces.

The Moscowitz Memorial Lectureship in Chemistry was established by friends and colleagues of Professor Albert Moscowitz (1929-1996) to honor his many contributions to molecular spectroscopy. He was known for his research on the interpretation of optical rotation and circular dichroism spectra in terms of the structures of chiral molecules. In collaboration with colleagues in the medical sciences, he developed important applications of his methods to biomedical systems. Throughout his career, Moscowitz held numerous visiting professorships at other universities, and served on the editorial boards of the leading journals in chemical physics. His work was honored by election as Foreign Member of the Danish Royal Academy of Sciences and Letters, and as a Fellow of the American Physical Society.

Zhen-Gang Wang earned his bachelor's degree in chemistry from Beijing University, and his doctorate in chemistry from the University of Chicago. He was a post-doctoral researcher at Exxon Research and Engineering and the University of California, Los Angeles. He is a professor of chemical engineering in the division of Chemistry and Chemical Engineering at the California Institute of Technology.

His numerous awards and honors include the Richard P. Feynman Prize for Excellence in Teaching (CALTECH); Fellow, American Physical Society; Alfred P. Sloan Award; Richard M. Badger Teaching Prize (Division of Chemistry and Chemical Engineering, CALTECH); Camille Dreyfus Teacher-Scholar Award; Visiting Research Fellow, The Institute for Advanced Studies, The Hebrew University, Jerusalem, Israel; and Camille and Henry Dreyfus New Faculty Award.

Research

Professor Wang's research group uses statistical mechanics to study a host of problems in the interdisciplinary areas of physical chemistry, materials science and biophysics. Current research projects include nucleation phenomena in the phase transformation of complex fluids, dynamics of topologically constrained polymers, structure and dynamics of physical gels, charge solvation effects on the thermodynamics of polymer blends and block copolymers, viral DNA packaging, and cell adhesion. A central goal of his group's work is to understand and predict properties based on the molecular characteristics of matter and systems. His researchers build coarse-grained models that capture the most essential features of the problems at hand without undue microscopic details, which are solved with a combination of modern analytical and numerical methods of statistical mechanics, including density functional theory, self-consistent field method, field-theoretical techniques, Monte Carlo simulation and Brownian Dynamics simulation.

Host: Professor Timothy Lodge
Refreshments will be served prior to the seminar.