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Polyelectrolytes in Multivalent Ionic Media: New Physics and New Materials

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Abstract

Multivalent interactions in polyelectrolyte systems can exhibit dramatic, non-monotonic effects, for example, switching forces from repulsive to attractive and back to repulsive in some cases. We have been studying these behaviour patterns with the surface forces apparatus (SFA) and electrochemical methods, such as cyclic voltammetry, which enables quantitative determination of the number of multivalent ions residing in thin layers of charged polymers. At fixed ionic strength, all the ions will cause strong shrinkage and condensation of the polystyrene sulfonate brushes over a narrow ratio range of multivalent to monovalent ions. When the multivalent ion is an oppositely charged polymer, new fluid phases can form. Charged blocks in copolymers lead to materials with new types of ordered phases. Effects of these multivalent interactions on supermolecular and biomolecular assembly will be discussed. There are many possibilities for the creation of new materials based on electrostatic assembly involving multivalent interactions.

Biography

Professor Matthew Tirrell is the founding Pritzker Director of The Institute for Molecular Engineering at The University of Chicago. Immediately prior to joining The University of Chicago in 2011, he was the Arnold and Barbara Silverman Professor and Chair of Bioengineering at the University of California, Berkeley, with additional appointments in chemical engineering and materials science and engineering, and as a Faculty Scientist at the Lawrence Berkeley National Laboratory. Professor Tirrell received a B.S. in Chemical Engineering at Northwestern University in 1973 and a Ph.D. in Polymer Science from the University of Massachusetts in 1977. From 1977 to 1999, he was a faculty member in the Departments of Chemical Engineering and Materials Science at the University of Minnesota, where he served as Head from 1995 to 1999. Professor Tirrell completed 10 years as Dean of Engineering at the University of California, Santa Barbara on 30 June 2009. His research has been in polymer surface properties, such as adsorption, adhesion, surface treatment, friction, lubrication, biocompatibility and self-assembly. He has co-authored about 350 papers and 1 book and has supervised about 90 Ph.D. students. Professor Tirrell has been a Sloan and a Guggenheim Fellow, Camille and Henry Dreyfus Teacher-Scholar. He is a member of the National Academy of Engineering, the American Academy of Arts & Sciences and the Indian National Academy of Engineering. He is a Fellow of the American Institute of Medical and Biological Engineers, the AAAS and the APS.