

Y. Tsori, U. Steiner: Polymers, Liquids and Colloids in Electric Fields

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The differentiation of the modern science is the general tendency during the last century. Not only physicists, chemists and biologists are speaking in different languages, but two next-door colleagues of the same department do not understand each other. In this connection the credit has to be given to the World Scientific for the attempt to destroy this Babylon wall of different languages by publishing the new “Series in Soft Condensed Matter”. After the first book “Polymer Thin Films”, the second book under review entitled “Polymers, Liquids and Colloids in Electric Fields” is dedicated to scientists who using the electric field as an instrument for an analysis of different phenomena in physics, chemistry, biology and material science. All review articles in this volume are written in a quite simple language accessible for graduate students and junior researches, alongside with teaching material for different phenomena in soft matter systems triggered by electric field.

An appearance of modulated phases is a general phenomenon induced by electric field. The pattern formation in different systems provides the subject matter for the first chapter written by D. Adelman and R. Rosensweig. They consider different magnetic and non-magnetic systems ranging from the nano- to the macro-scale including also some technical problems (magnetic fluids, block copolymers and fluidized beds). The extensive list of 123 references completes this general review of patternings in modern science, which is certainly beyond the scope of electric field.

Influence of electric field on critical temperature in binary mixture and on solvation effects in polar fluids are discussed in reviews written by K. Orzechowski and A. Onuki, respectively. It turns out that the comparatively simple problem of the shift of the critical temperature is not simple at all. Specifically, the decrease in an upper critical consolute temperature, observed in the majority of experiments, contradicts the theoretical predictions. Likewise, some nontrivial effects appear in polar fluids, such as increase of the surface tension at the interface for hydrophilic ion pairs, and decrease for hydrophilic and hydrophobic

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ion pairs, or arise of the long-range attractive interaction among ions, which, under strong solvation conditions, can dominate over the Coulomb interaction at short distances.

The next two chapters written by T. Russel and J. Bae, and by F. Mugele, describe the phenomena occurred at the interface between two immiscible fluids, and at the boundary between droplet and a solid substrate. In both cases, along with the theoretical description of the electrostatic pressure occurring across the interface and change of the contact angle, the practical applications are described, such as the extension the spacial resolution of lithographic processes below the diffraction limit of light, and the use of various electrowetting-driven microfluids devices.

Adding the light to microphase separation in block copolymers and macrophase separation in polymer mixtures is considered by Q. Tran-Cong-Miyata and H. Nakanishi. The combination of photochemical reactions and critical phenomena allows to get a mode-selector to spatiotemporal control and design morphology of multi-component polymers.

The remaining three chapters are related to the properties of copolymers in external electric field. M. Schick describes the general thermodynamic approach to phase transitions induced by electric field in a polarizable bulk copolymers and polymer films. The dynamics of the orientation of block copolymer nanostructures in solution aligned by the electric field is discussed by A. Boker and K. Schmidt, while A. Zvelindovsky and G. Sevink analyze this problem by the use of the dynamic version of self-consistent field theory and numerical methods.

In conclusion, I would strongly recommend this book to students, researches and engineers who are interested in the properties of different systems subjected to electric fields including nanotechnological and microfluids applications.