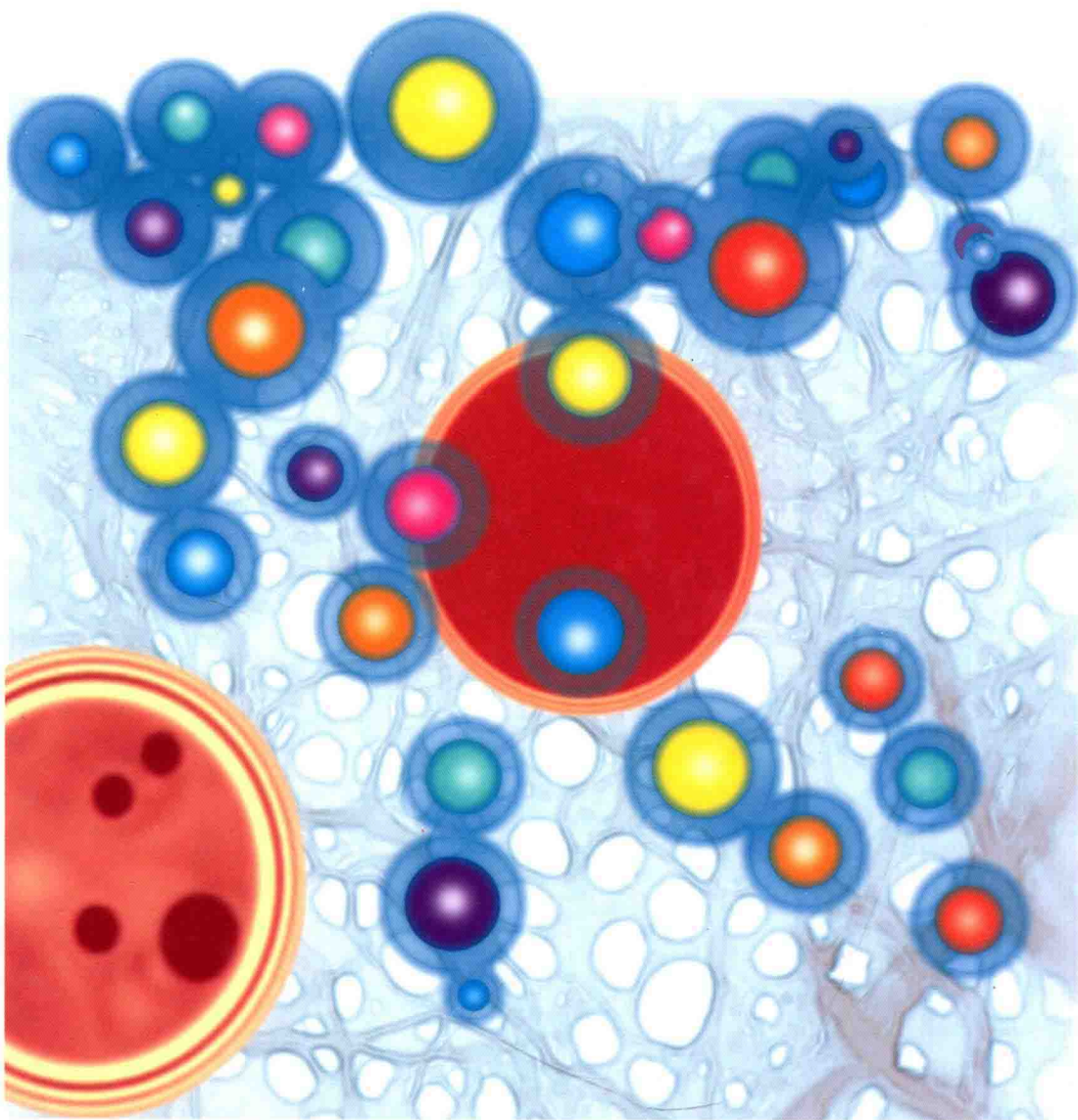


Edited by Dimo Platikanov  
and Dotchi Exerowa

 WILEY-VCH

# Highlights in Colloid Science





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*Dimo Platikanov and Dotchi Exerowa*



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## **The Editors**

### ***Professor Dimo Platikanov***

University of Sofia  
Department of Physical Chemistry  
Blvd James Bourchier 1  
1164 Sofia  
Bulgaria

### ***Professor Dotchi Exerowa***

Bulgarian Academy of Sciences  
Institute of Physical Chemistry  
1113 Sofia  
Bulgaria

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## Preface

The year 2007 saw two remarkable anniversaries: the 200th year since the publishing house Wiley was established in Manhattan, New York, and the 70th birthday of the distinguished scientist in the field of colloid and interface science Tharwat Tadros. It seemed, therefore, fitting that the publishers Wiley-VCH accepted the idea of preparing a book dedicated to Tharwat Tadros. As a result of invitations sent to well-known colloid and interface scientists the 16 review articles were received. Together with the publishers we entitled the book *Highlights in Colloid Science* – a title that may be a little pretentious but one that reflects well the content of this book. A great variety of topics is presented – colloid particles: aggregation, deposition and characterization; surfactant solutions: micelles, interfacial properties and the manipulation of DNA; delivery agents: microgel particles and cubosomes; thin liquid films; colloidal liquids; structure-mechanical barrier; phase transitions in confined systems; papermaking: heteroflocculation and cellulose fibrils; wetting phenomena in crude oil; highly concentrated emulsions, and so on.

The reviews, with different scopes, offered here are written by leading scientists from all over the world. They are comprehensive, with many references, and they should be very useful for those engaged (both in academia and in industry) in fundamental and applied studies in the area of colloid and interface science. As it proved difficult to arrange the reviews in a particular order, they are presented here according to the time the manuscript was received. Before the reviews, a short biography and summary of selected scientific achievements of Tharwat Tadros is given by Brian Vincent, the immediate past president of the International Association of Colloid and Interface Scientists.

We express our gratitude to the invited authors and their co-authors for the preparation of these high level review articles, as well as to the staff of Wiley-VCH for producing this excellent volume

Sofia, February 2008

*Dimo Platikanov and  
Dotchi Exerowa*



## Tharwat F. Tadros

Tharwat F. Tadros was born on 29 July 1937 near Luxor in Upper Egypt, where he grew up and went to school. He subsequently attended the University of Alexandria, where he obtained a first class honors BSc degree in 1956 (aged 19), followed by an MSc degree in 1959. He then pursued his PhD studies in electrochemistry at Alexandria with Professor Sadek. Afterwards, Tharwat was appointed to a lectureship in chemistry at that university. In 1966 he sought a position overseas and began a two-year postdoctoral position with Hans Lyklema in the Agricultural University in Wageningen, The Netherlands. There he met Wikie Buter, a Dutch lady who was working in plant protection at the University. They married in the summer of 1969 in Wassenaar, near Den Haag. Before this happy event, Tharwat had intended returning to his lectureship position in Alexandria after his period in Wageningen, but now he sort a position in Holland, and went to TNO in Delft for two years (1968–1969), where he worked on electrochemical machining. After that he applied to, and was awarded a position with, ICI Plant Protection Division, in Jealotts Hill, Berkshire, in the UK.

During his early days at Jealotts Hill, as well as running a strong product development group, Tharwat was encouraged to make contacts with academics. As a result, Tharwat started his lifelong collaborations with many universities worldwide, initially in Bristol with Ron Ottewill and myself, soon followed by collaborations at Imperial College, with Anita Bailey and Paul Luckham. Subsequently, he worked with academics from many others institutions, including Barcelona (Conxita Solans), Crackow (Piotr Warszynski and Maria Zembala), Groningen (H. Busscher), Liverpool Polytechnic (Alec Smith), Nottingham (Mike Hey and Bob Davies), Reading (Thelma Herrington), Sofia (Dotchi Exerowa and Dimo Platikanov) and of course further collaborations with people from Wageningen.

Over the years, Tharwat built up a strong team of coworkers at Jealotts Hill, including Chris Hart, Peter Wynn, David Heath, Phil Taylor and many others. He has also had many visitors and students working with him in his laboratory. He stayed through the transition to Zeneca Agrochemicals, and, although Tharwat formally retired in 1994, he is still employed as a consultant to this day by Syngenta, who now occupy the site. Indeed his ongoing consulting roles and short courses for a wide range of companies and organizations are legendary.

Tharwat is the author, or a co-author, of around 270 published papers, eight books (see later) and six patents (as at the end of 2007). Many of these are a result of his ongoing collaborations with academics around the world. Tharwat's PhD work in Alexandria with Professor Sadek was largely concerned with the conduction properties of electrolyte solutions, in particular solutions of acids and their mixtures. As mentioned earlier, his first papers in surface and colloid science, as such, were with Hans Lyklema on the electrical double layer properties of the porous silica/aqueous electrolyte interface. After his move to ICI, one of his major interests became the adsorption of polymers at solid/solution interfaces. My group collaborated extensively with Tharwat in this area at that time. In the 1960s industrial researchers, in particular, had started to study this topic in a systematic manner, using carefully designed, synthetic polymers, especially block or graft copolymers; this early work included researchers at ICI, in particular at the Paints Division. Moreover, at that time, people were beginning to build theories of polymers at interfaces and the steric interaction between polymer-coated particles.

Tharwat and I decided to test some of these emerging ideas using a model aqueous-based system, namely polystyrene particles plus, what is effectively a block copolymer, namely poly(vinyl alcohol-co-vinyl acetate) [PVA]. We had our first, ICI-funded, joint PhD student working on this topic, Mike Garvey. Because it was clear even then that polymer molecular weight is an important parameter in determining the properties of the adsorbed polymer layer, such as the adsorbed amount and the adsorbed layer thickness, as well as in steric stabilization, we decided to fractionate a commercial sample of PVA. This Mike achieved using a GPC column. Those early studies by Mike Garvey were followed up by a succession of students, working with Tharwat and myself. Moreover, around 1980 we were joined in this research in Bristol by Terry Cosgrove, and a mathematically gifted young PhD student, seconded from ICI (Runcorn), Trevor Crowley, and we started to apply the newer techniques of small-angle neutron scattering (SANS) and solid-state NMR to studying polymers at interfaces. Using SANS, thanks largely to Trevor, who was able to solve the complex Laplace transforms involved, we were able to determine the segment density profile of adsorbed polymers normal to the particle surface. Terry's interests in NMR enabled us to determine the bound fraction of segments (i.e. in "trains" as opposed to tails or loops). Much of this early work on polymer adsorption and steric stabilization, inspired by Tharwat, led to a much better practical understanding of how polymers could be used in commercial formulations, such as agrochemicals, to control dispersion stability and flocculation.

The other main field of study that Tharwat and I explored together in those early days was the adsorption of small positive latex particles on much larger negative particles, and how the adsorbed particles could act as particle "bridging" flocculants at low coverage, by analogy with polymer flocculants. It was felt that this might lead to a more "robust" method of achieving controlled, reversible flocculation in particle suspensions – a very important topic for agrochemical dispersions, such as pesticides, herbicides and fungicides, where it is necessary to prevent "claying," that is, the hard bed of closed-packed particles that forms when particles, stable with respect to aggregation, settle slowly with time on standing.



Tharwat's collaborations with Ron Ottewill at Bristol have led to papers on topics as diverse as understanding settling in Newtonian and non-Newtonian media (also with Jim Goodwin and Richard Buscall), and to fundamental studies on microemulsions (also with A.T. Florence).

For the last 20 years or so, however, Tharwat's principle academic collaboration has been with Imperial College. His earlier work with Anita Bailey was focused on electro-spraying, a very important application being the spraying of agrochemical formulations. The work with Paul Luckham, on the other hand, has mostly been concerned with combining Paul's expertise in measuring the forces between surfaces (using the surface forces apparatus or the atomic force microscope) with Tharwat's expertise in rheology. Indeed, Tharwat has established himself as one of the leading experts on what one might call "the practical rheology of industrial formulations."

Two of the main European collaborations Tharwat has had in recent years have been the groups of Dotchi Exerowa in Sofia and that of Conxita Solans in Barcelona. With Dotchi the work has focused on foam and emulsion films and with Coxita (plus Paul Luckham) on the stabilization of latex particles. Indeed in much of this latter work on foams, emulsions, and particle dispersions, very efficient stabilizers, based on hydrophobically-modified, sugar-based polymers, have been studied. It was observed, for example, that, when these are added, polymer latex dispersions are stable in  $\text{Na}_2\text{SO}_4$  solutions of up to  $1.5 \text{ mol dm}^{-3}$ .

I am aware that this selection from Tharwat's large research activity has been very selective, so I apologies to anyone where no mention of them, or their work with Tharwat, has been made!

Tharwat has not only contributed widely to the research-base in colloid science, but he has also made major contributions to the broader education not only of younger colloid scientists in universities but also to colloid scientists of all ages, through the very many industrial consultancies, courses and seminars he has given over the years.

His more formal university connections include appointments as a visiting professor at three universities in the UK: Imperial College (1988), Bristol (1988) and Reading (1994). As well as co-supervising PhD students with academics from various institutions, where ICI provided at least partial funding, Tharwat has been an external examiner for PhD students in many places, as well as for MSc courses. For example, he was the external examiner for the MSc advanced course in surface chemistry and colloids at Bristol – twice (1983–1985 and then 1992–1994).

Tharwat has received many invitations to give plenary or keynote lectures. He has given (and is still giving!) specialist courses on rheology, surfactants, emulsions, the dispersion of powders in liquids, wetting, spreading and adhesion, amongst other topics. He has edited six books, and authored two other books: *Surfactants in Agrochemicals* (1994) and *Applied Surfactants* (2005). He has been a senior editor for *Colloids and Surfaces* and for *Advances in Colloid and Interface Science* (both for Elsevier). He is also currently editor of two series published by Wiley-VCH: *Colloids and Interface Science Series* (two volumes published in 2006 and others in the pipeline), and *Topics in Colloid and Interface Science* (commencing 2007). Tharwat has

acted as a reviewer and evaluator for many organizations, including the UK government funding body (the Engineering and Physical Science Research Council, EPSRC), the NSF in the USA and the Consultative Board of the University of Alexandria.

Tharwat served as Chair of the UK Society of Chemical Industry (SCI) Surface and Colloid Chemistry section committee (1987–1989) and was elected President of IACIS (1990–1992). All this work, in and for colloid science, has been recognized by the award of a number of medals and named lectureships. These include the UK Royal Society of Chemistry's (RSC) Colloid and Surface Chemistry Medal (1989), the RSC's silver medal and industrial lectureship (1990), and the SCI's Founder's (now the Rideal) lecture (1991).

Tharwat and Wikie live in Wokingham in the South of England, and are very proud parents and grandparents. Wikie has had a very successful life in the art world, with many exhibitions of her work. I know that Tharwat is very proud of all his family, both in the UK and back in Egypt. May he long continue into the future as one of colloid science's "father figures" and a good friend to many of us.

Bristol, December 2007

*Brian Vincent*

## List of Contributors

### **Zbigniew Adamczyk**

Institute of Catalysis and Surface  
Chemistry  
Polish Academy of Sciences,  
ul. Niezapominajek 8  
30-239 Cracow  
Poland

### **Idit Amar-Yuli**

Casali Institute of Applied Chemistry  
The Institute of Chemistry  
The Hebrew University of Jerusalem  
91904 Jerusalem  
Israel

### **Elena A. Amelina<sup>†</sup>**

Moscow State University  
Department of Chemistry  
119899 Moscow  
Russia

### **Martin Andresen**

Ugelstad Laboratory  
Department of Chemical Engineering  
Norwegian University of Science and  
Technology  
7491 Trondheim  
Norway

### **Abraham Aserin**

Casali Institute of Applied Chemistry  
The Institute of Chemistry  
The Hebrew University of Jerusalem  
91904 Jerusalem  
Israel

### **Jakub Barbasz**

Institute of Catalysis and Surface  
Chemistry  
Polish Academy of Sciences,  
ul. Niezapominajek 8  
30-239 Cracow  
Poland

### **James K. Beattie**

School of Chemistry  
University of Sydney  
Sydney NSW 2006  
Australia

### **Ludmila Boinovich**

Russian Academy of Sciences  
A. N. Frumkin Institute of Physical  
Chemistry and Electrochemistry  
31 Leninsky prosp  
119991 Moscow  
Russia

**Melanie Bradley**

School of Chemistry  
University of Bristol  
Bristol BS8 1TS  
UK

**Diana Costa**

Physical Chemistry 1  
Centre for Chemistry and Chemical  
Engineering  
Lund University  
P.O. Box 124  
22100 Lund  
Sweden  
and

Department of Chemistry  
University of Coimbra  
3004-535 Coimbra  
Portugal

**Paul Davies**

School of Chemistry  
University of Bristol  
Bristol BS8 1TS  
UK

**Rita S. Dias**

Physical Chemistry 1  
Centre for Chemistry and Chemical  
Engineering  
Lund University  
P.O. Box 124  
22100 Lund  
Sweden

**Alexandre Emelyanenko**

A. N. Frumkin Institute of Physical  
Chemistry and Electrochemistry  
Russian Academy of Sciences  
31 Leninsky prosp  
119991 Moscow  
Russia

**Jordi Esquena**

Institut de Química Avançada  
de Catalunya (IQAC)  
Consejo Superior de Investigaciones  
Científicas (CSIC)  
Jordi Girona 18-26  
08034-Barcelona  
Spain

**Dotchi Exerowa**

Institute of Physical Chemistry  
Bulgarian Academy of Sciences  
1113 Sofia  
Bulgaria

**Valentin B. Fainerman**

Medical Physicochemical Centre  
Donetsk Medical University  
83003 Donetsk  
Ukraine

**Gerard J. Fleer**

Laboratory of Physical Chemistry and  
Colloid Science  
Wageningen University  
6703 HB Wageningen  
The Netherlands

**Nissim Garti**

Casali Institute of Applied Chemistry  
The Institute of Chemistry  
The Hebrew University of Jerusalem  
91904 Jerusalem  
Israel

**Andreas Hannisdal**

Aibel AS  
Technology and Products  
1375 Billingstad  
Norway

**Robert J. Hunter**

School of Chemistry  
University of Sydney  
Sydney NSW 2006  
Australia

**Ana B. Jódar-Reyes**

Universidad de Extremadura  
Dpto. de Física Aplicada  
Facultad de Veterinaria  
Avda. de la Universidad s/n  
10071 Cáceres  
Spain

**Frans A.M. Leermakers**

Wageningen University  
Lab. of Physical Chemistry and  
Colloid Science  
Dreijenplein 6  
6703 HB Wageningen  
The Netherlands

**Simone Less**

Ugelstad Laboratory  
Department of Chemical Engineering  
Norwegian University of Science and  
Technology (NTNU)  
7491 Trondheim  
Norway

**Dima Libster**

Casali Institute of Applied Chemistry  
The Institute of Chemistry  
The Hebrew University of Jerusalem  
91904 Jerusalem  
Israel

**Björn Lindman**

Physical Chemistry 1  
Centre for Chemistry and  
Chemical Engineering  
Lund University  
P.O. Box 124  
22100 Lund  
Sweden  
and

Department of Chemistry  
University of Coimbra  
3004-535 Coimbra  
Portugal

**Johannes Lyklema**

Wageningen University  
Lab. of Physical Chemistry and  
Colloid Science  
Dreijenplein 6  
6703 HB Wageningen  
The Netherlands

**Heléne Magnusson**

Ugelstad Laboratory  
Department of Chemical Engineering  
Norwegian University of Science and  
Technology (NTNU)  
7491 Trondheim  
Norway

**M. Graça Miguel**

Department of Chemistry  
University of Coimbra  
3004-535 Coimbra  
Portugal

**Reinhard Miller**

Max-Planck-Institut für Kolloid- und  
Grenzflächenforschung  
14424 Potsdam  
Germany

**M. Carmen Morán**

Department of Chemistry  
University of Coimbra  
3004-535 Coimbra  
Portugal

**Malgorzata Nattich**

Institute of Catalysis and Surface  
Chemistry  
Polish Academy of Sciences,  
ul. Niezapominajek 8  
30-239 Cracow  
Poland

**Boris A. Noskov**

St. Petersburg State University  
Chemical Faculty  
198904 St. Petersburg  
Russia

**Richard W. O'Brien**

School of Chemistry  
University of Sydney  
Sydney NSW 2006  
Australia

**Aksana M. Parfenova**

Moscow State University  
Department of Chemistry  
119899 Moscow  
Russia

**Jordon T. Petkov**

Unilever R&D Port Sunlight  
Quarry Road East  
Bebington CH63 3JW  
UK

**Dimo Platikanov**

Department of Physical Chemistry  
University of Sofia  
1164 Sofia  
Bulgaria

**Venkataramana Runkana**

Tata Research Development and  
Design Centre  
A Division of Tata Consultancy  
Services Limited  
54-B, Hadapsar Industrial Estate  
Pune 411013  
India

**Eugene D. Shchukin**

Moscow State University  
Department of Chemistry  
119899 Moscow  
Russia

*and*

Institute for Physical Chemistry and  
Electrochemistry  
Russian Academy of Sciences  
117915 Moscow  
Russia

*and*

Department of Geography  
Johns Hopkins University  
2704 Hanson Avenue  
Baltimore MD 21218  
USA

**Johan Sjöblom**

Ugelstad Laboratory  
Department of Chemical Engineering  
Norwegian University of Science and  
Technology (NTNU)  
7491 Trondheim  
Norway

**Conxita Solans**

Institut de Química Avançada  
de Catalunya (IQAC)  
Consejo Superior de Investigaciones  
Científicas (CSIC)  
Jordi Girona 18-26  
08034-Barcelona  
Spain

**Ponisseril Somasundaran**

NSF Industry/University Cooperative  
 Research Center for Advanced Studies  
 in Novel Surfactants  
 School of Engineering and Applied  
 Science  
 Columbia University  
 New York NY 10027  
 USA

**Per Stenius**

Ugelstad Laboratory  
 Department of Chemical Engineering  
 Norwegian University of Science and  
 Technology  
 7491 Trondheim  
 Norway  
*and*  
 Laboratory of Forest Products  
 Chemistry  
 Helsinki University of Technology  
 P.O. Box 6300  
 02015 TKK  
 Finland

**Remco Tuinier**

Forschungszentrum Jülich  
 IFF-Soft Matter group  
 52425 Jülich  
 Germany  
 Current affiliation:  
 DSM Research  
 ACES  
 P.O. Box 18  
 6160 MD Geleen  
 The Netherlands

**Theo G.M. van de Ven**

NSERC/Paprican Industrial Research  
 Chair in "Colloid and Papermaking  
 Chemistry"  
 Pulp & Paper Research Centre  
 Department of Chemistry  
 McGill University  
 Montreal  
 Canada

**Brian Vincent**

School of Chemistry  
 University of Bristol  
 Bristol BS8 1TS  
 UK

## Contents

	<b>Preface</b>	<i>XI</i>
	<b>Tharwat F. Tadros</b>	<i>XIII</i>
	<b>List of Contributors</b>	<i>XVII</i>
<b>1</b>	<b>Orthokinetic Heteroflocculation in Papermaking</b>	<b>1</b>
	<i>Theo G.M. van de Ven</i>	
1.1	Introduction	1
1.2	Polymer-Induced Orthokinetic Heteroflocculation	2
1.2.1	Polymer Adsorption and Desorption on Fibers and Colloids	3
1.2.2	Deposition of Colloids on Fibers Subjected to Shear	5
1.2.3	Polymer Transfer	10
1.2.4	Time Dependence of Deposition and Detachment Rate Coefficients	12
1.3	Heteroflocculation Among Colloids	13
1.4	Heteroflocculation of Fines and Colloids	17
1.5	Concluding Remarks	18
	References	19
<b>2</b>	<b>Uptake and Release of Active Species into and from Microgel Particles</b>	<b>21</b>
	<i>Melanie Bradley, Paul Davies, and Brian Vincent</i>	
2.1	Introduction to Microgel Particles	21
2.2	Absorption of Small Molecules	23
2.3	Absorption of Surfactants	25
2.4	Absorption of Polymers and Proteins	29
2.5	Absorption of Nanoparticles	34
	References	38
<b>3</b>	<b>Stability of Fluorinated Systems: Structure-Mechanical Barrier as a Factor of Strong Stabilization</b>	<b>41</b>
	<i>Eugene D. Shchukin, Elena A. Amelina<sup>†</sup>, and Aksana M. Parfenova</i>	
3.1	Introduction	41



3.2	Rheological Studies of Interfacial Adsorption Layers in Fluorinated Systems	42
3.3	Studies of the Rupture and Coalescence of Individual Droplets	44
3.4	Studies of the Interaction of Hydrophobized Solid Surfaces in Nonpolar Liquids	47
3.5	Discussion	49
3.6	Conclusion	51
	References	51
<b>4</b>	<b>Particle Characterization Using Electro-Acoustic Spectroscopy</b>	<b>55</b>
	<i>Richard W. O'Brien, James K. Beattie, and Robert J. Hunter</i>	
4.1	Introduction	55
4.2	Understanding the ESA Effect	55
4.3	The Dynamic Mobility	59
4.4	The Dynamic Mobility for Thin Double Layer Systems	63
4.5	Particles with Adsorbed Polymer Layers	65
4.6	Surface Conductance	70
4.7	Nanoparticles	73
	References	76
<b>5</b>	<b>Modeling the Structure and Stability of Charged Hemi-Micelles at the Air–Water Interface</b>	<b>79</b>
	<i>Johannes Lyklema, Ana B. Jódar-Reyes, and Frans A.M. Leermakers</i>	
5.1	Introduction	79
5.2	Thermodynamics	80
5.3	Fundamentals of SCF Theory and the Molecular Model	82
5.3.1	The Lattice	82
5.3.2	From Volume Fractions to Potentials	83
5.3.3	From Potentials to Volume Fractions	86
5.3.4	Grand Potential	88
5.4	Results	90
5.4.1	Stability Analysis	91
5.4.2	Structural Analysis	94
5.5	Conclusions	95
	References	96
<b>6</b>	<b>Foam, Emulsion and Wetting Films Stabilized by Polymeric Surfactants</b>	<b>97</b>
	<i>Dotchi Exerowa and Dìmo Platikanov</i>	
6.1	Introduction	97
6.2	Micrinterferometric Method for Investigation of Thin Liquid Films	98
6.3	Intercation Forces in Foam Films	100
6.3.1	Foam Films Stabilized by A-B-A Block Copolymers. Brush-to-Brush Interaction	100