

SURFACTANTS IN SOLUTION

VOLUME 1

Edited by
K. L. Mittal and B. Lindman

21.44075
S 961
71

VOLUME 1

Surfactants in Solution

Edited by

K.L. Mittal

IBM Corporation, Hopewell Junction, New York

and

B. Lindman

University of Lund, Lund, Sweden

103

PLENUM PRESS • NEW YORK AND LONDON



Library of Congress Cataloging in Publication Data

Main entry under title:

Surfactants in solution.

"Proceedings of an international symposium on surfactants in solution, held June 27-July 2, 1982, in Lund, Sweden"—T.p. verso.

Includes bibliographical references and indexes.

1. Surface active agents—Congresses. 2. Solution (Chemistry)—Congresses. 3. Micelles—Congresses. I. Mittal, K. L., 1945–. II. Lindman, Björn, 1943–

TP994.S88 1983

668'.1

83-19170

ISBN 0-306-41483-X (v. 1)

ISBN 0-306-41484-8 (v. 2)

ISBN 0-306-41485-6 (v. 3)

Proceedings of an international symposium on Surfactants in Solution,
held June 27-July 2, 1982, in Lund, Sweden

© 1984 Plenum Press, New York
A Division of Plenum Publishing Corporation
233 Spring Street, New York, N.Y. 10013

All rights reserved

No part of this book may be reproduced, stored in a retrieval system, or transmitted,
in any form or by any means, electronic, mechanical, photocopying, microfilming,
recording, or otherwise, without written permission from the Publisher

Printed in the United States of America

PREFACE

This and its companion Volumes 2 and 3 document the proceedings of the 4th International Symposium on Surfactants in Solution held in Lund, Sweden, June 27-July 2, 1982. This biennial event was christened as the 4th Symposium as this was a continuation of earlier conferences dealing with surfactants held in 1976 (Albany) under the title "Micellization, Solubilization, and Microemulsions"; in 1978 (Knoxville) under the title "Solution Chemistry of Surfactants"; and in 1980 (Potsdam) where it was dubbed as "Solution Behavior of Surfactants: Theoretical and Applied Aspects." The proceedings of all these symposia have been properly chronicled.^{1,2,3} The Lund Symposium was billed as "Surfactants in Solution" as both the aggregation and adsorption aspects of surfactants were covered, and furthermore we were interested in a general title which could be used for future conferences in this series. As these biennial events have become a well recognized forum for bringing together researchers with varied interests in the arena of surfactants, so it is amply vindicated to continue these, and the next meeting is planned for July 9-13, 1984 in Bordeaux, France under the cochairmanship of K. L. Mittal and P. Bothorel. The venue for 1986 is still open, although India, inter alia, is a good possibility. Apropos, we would be delighted to entertain suggestions regarding where and when these biennial symposia should be held in the future and you may direct your response to KLM.

The response to these biennial events has been growing and as a matter of fact we had to limit the number of presentations in Lund. Even with this restriction, the Lund Symposium program had 140 papers from 31 countries by more than 300 authors. So it is quite patent that this meeting was a veritable international symposium both in spirit and contents. It should be added that the program contained a number of overviews by prominent researchers, as it is imperative to include some overviews to cover the state-of-knowledge of the topic under discussion.

As for these proceedings [containing 126 papers (2156 pages) by 324 authors from 29 countries], these are arranged in nine parts. Parts I and II constitute Volume 1; Parts III-VI comprise Volume 2; and Parts VII-IX are the subject of Volume III. Apropos,

the papers in the proceedings have been rearranged (from the order they were presented) in a more logical manner. Among the topics covered include: Phase behavior and phase equilibria in surfactants in solution; structure, dynamics and characterization of micelles; thermodynamic and kinetic aspects of micellization; mixed micelles; solubilization; micellar catalysis and reactions in micelles; reverse micelles; microemulsions and reactions in microemulsions; application of surfactants in analytical chemistry; adsorption and binding of surfactants; HLB; polymerization of organized surfactant assemblies; light scattering by liquid surfaces; and vesicles.

A few salient aspects of these proceedings should be recorded for posterity. All papers were reviewed by qualified reviewers so as to maintain the highest standard. As a result of this, most papers were returned to respective authors for major/minor revisions and some did not pass the review. In other words, these proceedings are not simply a collection of unreviewed papers, rather the peer review was an integral part of the total editing process. It should be added that we had earnestly hoped to include discussions at the end of each paper or group of allied papers, but in spite of constant exhortation, the number of written questions received did not warrant undertaking such endeavor. However, it must be recorded that there were many spontaneous and brisk discussions both formally in the auditorium and informally in other more suitable (more relaxed) places. Most often the discussions were enlightening, but on occasions one could feel some enthalpy as these tended to be exothermic.

Also a general concern was expressed about the possibility of correlating research done in different laboratories. In particular in the microemulsion field it was felt that a few selected, stable and well-defined systems should be chosen for collaborative work between a number of active groups using a variety of techniques. The response to such discussion (initiated by Prof. M. Kahlweit, Göttingen) was very heartening and culminated in the so-called Lund Project (coordinator Prof. P. Stenius, Stockholm), which is a coordinated collaboration between a number of research groups in different countries. A report meeting was hosted by M. Kahlweit in Göttingen in the spring 1983 and further results will be presented in Bordeaux in 1984. In addition, throughout the meeting, small groups of people were seen to be leisurely discussing more specific topics of mutual interest. In other words, there were ample and lively discussions in various forms during the span of this symposium.

Coming back to the proceedings, even a cursory look at the Table of Contents will convince even the most skeptic that the field of surfactants in solutions has come a long way, and all signals indicate that the accelerated tempo of interest and research in this area is going to continue. Also it is quite clear that as we learn more about the amphiphilic molecules, more excit-

ing research areas and pleasant applications will emerge. It should be added that these proceedings cover a wide spectrum of topics by a legion of prominent researchers and provide an up-to-date coverage of the field. The coverage is inter- and multidisciplinary and both overviews and original unpublished research reports are included. Also it should be pointed out that both the aggregation and adsorption of surfactants are accorded due coverage. These proceedings volumes along with the earlier ones in this vein (total ~ 5000 pages) should serve as a repository of current thinking and research dealing with the exciting field of surfactants in solution. Also these volumes should appeal to both veteran and neophyte researchers. The seasoned researchers should find these as the source for latest research results, and these should be a fountainhead of new research ideas to the tyro.

Acknowledgements: One of us (KLM) is thankful to the appropriate management of IBM Corporation for permitting him to participate in this symposium and to edit these proceedings. His special thanks are due to Steve Milkovich for his cooperation and understanding during the tenure of editing. Also KLM would like to acknowledge the assistance and cooperation of his wife, Usha, in more ways than one, and his darling children (Anita, Rajesh, Nisha and Seema) for creating only low decibel noise so that Daddy could concentrate without frequent shoutings. The time and effort of the reviewers is sincerely appreciated, as the comments from the peers are a desideratum to maintain standard of publications. We are appreciative of Phil Alvarez, Plenum Publishing Corp., for his continued interest in this project. Also we would like to express our appreciation to Barbara Mutino for providing excellent and prompt typing service. Our thanks are due to the members of the local Organizing Committee (Thomas Ahlnäs, Thomas Andersson, Gunnar Karlström, Ali Khan, Mary Molund, Gerd Olofsson, Nancy Simonsson and Marianne Swärd) who unflinchingly carried out the various chores demanded by a symposium of this magnitude. The financial support of the Swedish Board for Technical Development, the Swedish National Science Research Council, and the University of Lund is gratefully acknowledged.

K. L. Mittal
IBM Corporation
Hopewell Junction, NY 12533

B. Lindman
University of Lund
Lund, Sweden

1. K. L. Mittal, Editor, Micellization, Solubilization and Microemulsions, Vols. 1 & 2, Plenum Press, New York, 1977.
2. K. L. Mittal, Editor, Solution Chemistry of Surfactants, Vols. 1 & 2, Plenum Press, New York, 1979.
3. K. L. Mittal and E. J. Fendler, Editors, Solution Behavior of Surfactants: Theoretical and Applied Aspects, Vols. 1 & 2, Plenum Press, New York 1982.

CONTENTS

PART I: PHASE BEHAVIOR AND PHASE EQUILIBRIA IN SURFACTANT SOLUTIONS

Principles of Phase Equilibria in Surfactant - Water Systems B. Jönsson, P.-G. Nilsson, B. Lindman, L. Guldbrand and H. Wennerström	3
On the Phase Behavior of Systems of the Type H_2O - Oil - Nonionic Surfactant - Electrolyte M. Kahlweit and E. Lessner	23
Phase Equilibria in and Lattice Models for Nonionic Surfactant-Water Mixtures J. C. Lang	35
Amphiphilic Aggregates in a Lyotropic Nematic Phase J. Charvolin, Y. Hendrikx and M. Rawiso	59
Liquid Crystalline Structures Occurring in Aqueous Systems of a Totally Fluorinated Fatty Acid and Some of its Salts K. Fontell	69
Water 2H and ^{17}O NMR in Dodecylammonium Chloride/ D_2O Lyotropic Mesophases B. Robin-Lherbier, D. Canet, J. P. Marchal and J. Brondeau	79
The Interaction Between Water and Ethylene Oxide Groups in Oligo (Ethylene Glycol) Dodecyl Ethers as Studied by 2H NMR in Liquid Crystalline Phases T. Klason and U. Henriksson	93
Surfactant Alkyl Chain Mobility and Order in Micelles and Microemulsions T. Ahlnäs, O. Söderman, H. Walderhaug and B. Lindman	107
Thermodynamics of Partially Miscible Micelles and Liquid Crystals R. F. Kamrath and E. I. Franses	129

^{31}P and ^2H NMR Studies of Phase Equilibria in the Three Component System: Monoolein-Dioleoylphosphatidylcholine-Water H. Gutman, G. Arvidson, K. Fontell and G. Lindblom	143
Micelle Formation and Phase Equilibria of Surface Active Components of Wood P. Stenius, H. Palonen, G. Ström and L. Ödberg	153
Fluid Microstructures of Sodium 4-(1'-Heptylnonyl) Benzenesulfonate Mixtures W. G. Miller, F. D. Blum, H. T. Davis, E. I. Franses, E. W. Kaler, P. K. Kilpatrick, K. E. Nietering, J. E. Puig and L. E. Scriven	175
Phase Structures and Phase Diagrams of Some Surfactant Systems with Divalent Counterions. Effect of Ca^{2+} and Mg^{2+} Counterions on the Stability of Liquid Crystalline Phases A. Khan, K. Fontell and B. Lindman	193
A New Optically Isotropic Phase in the Dilute Region of the Sodium Octanoate - Decanol - Water System W. J. Benton and C. A. Miller	205
NMR and Polarized Emission Studies of Cubic Phases and Model Membranes P.-O. Eriksson, L. B.-Å. Johansson and G. Lindblom	219
The Use of Freeze-Fracture and Freeze-Etching Electron Microscopy for Phase Analysis and Structure Determination of Lipid Systems T. Gulik-Krzywicki, L. P. Aggerbeck and K. Larsson	237
The Structure of Plasma Lipoproteins: Evaluation by X-Ray and Neutron Small-Angle Scattering P. Laggner	259
PART II. STRUCTURE, DYNAMICS AND CHARACTERIZATION OF MICELLES	
The Packing of Amphiphile Chains in Micelles and Bilayers D. W. R. Gruen and E. H. B. de Lacey	279
Molecular Organization in Amphiphilic Aggregates K. A. Dill	307

The Nature of the Surfactant-Block Model of Micelle Structure P. Fromherz	321
Structure in Micellar Solutions: A Monte Carlo Study P. Linse and B. Jönsson	337
Multi-Method Characterization of Micelles F. M. Menger	347
Tracer Self-Diffusion Studies of Surfactant Association N. Kamenka, M. Puyal, B. Brun, G. Haouche and B. Lindman	359
An Introduction to Neutron Scattering on Surfactant Micelles in Water B. Cabane, R. Duplessix and T. Zemb	373
Light Scattering and Small-Angle Neutron Scattering Investigations of Double-Tailed Surfactants in Aqueous Solutions L. J. Magid, R. Triolo, E. Gulari and B. Bedwell	405
Viscoelastic Detergent Solutions H. Hoffmann, H. Rehage, W. Schorr and H. Thurn	425
The Effect of Intermicellar Interactions on Interpretations of Micellar Diffusivities by Dynamic Light Scattering D. F. Nicoli, R. B. Dorshow and C. A. Bunton	455
Laser-Light Scattering Study of Nonionic Micelles in Aqueous Solution V. Degiorgio and M. Corti	471
Light Scattering from Concentrated Solutions of Sodium Octanoate Micelles M. Drifford, T. Zemb, M. Hayoun and A. Jehanno	487
NMR and ESR Studies of Dibutylphosphate Micellar Aggregates S. Belaïd and C. Chachaty	501
Conformational Change of Surfactants Due to Association; Raman Scattering and Carbon-13 NMR Studies H. Okabayashi and K. Matsushita	517
An NMR Study of Paramagnetic Relaxation Induced in Octanoate Micelles by Divalent Ions T. Zemb and C. Chachaty	527

ESR Study of Spin Labels in Surfactant Micelles P. Baglioni, M. F. Ottaviani, G. Martini and E. Ferroni	541
Spin Label Study of Molecular Aggregates M. Schara and M. Nemec	559
Micellar Structure and Water Penetration Studied by NMR and Optical Spectroscopy K. A. Zachariasse, B. Kozankiewicz and W. Kühnle	565
Solubilization and Water Penetration into Micelles and Other Organized Assemblies as Indicated by Photochemical Studies D. G. Whitten, J. B. S. Bonilha, K. S. Schanze and J. R. Winkle	585
Critique of Water Penetration Studies in Micelles using Extrinsic Probes K. N. Ganesh, P. Mitra and D. Balasubramanian	599
The Size of Sodium Dodecyl Sulfate Micelles with Various Additives: A Fluorescence Quenching Study M. Almgren and S. Swarup	613
Fluorescence Quenching Aggregation Numbers in a Non-Ionic Micelle Solution J.-E. Löfroth and M. Almgren	627
Fluorescence Quenching Equilibria Studies in Ionic Micelles in Aqueous Media K. S. Birdi, M. Meyle and E. Stenby	645
Fluorescence Quenching in Micellar Systems F. C. De Schryver, Y. Croonen, E. Geladé, M. Van der Auweraer, J. C. Dederen, E. Roelants, and N. Boens	663
FT-IR Studies of Aqueous Surfactants: The Temperature Induced Micelle Formation H. H. Mantsch, V. B. Kartha and D. G. Cameron	673
About the Contributors	691
Index	xxiii

CONTENTS OF VOLUME 2

PART III. THERMODYNAMIC AND KINETIC ASPECTS
OF MICELLIZATION

Micellization as a Nucleation Phenomenon with Variable Surface Tension and Cut-off at Zero Surface Tension T. S. Sørensen	709
Computation of the Micelle-Size-Distribution from Experimental Measurements A. Ben-Naim	731
Thermodynamics of Micelle Formation in Aqueous Media = "Second Virial Coefficient" K. S. Birdi, E. Stenby and D. K. Chattoraj	745
Thermodynamics of Micellization and Solubilization of Pentanol in the System Water + Sodium N-Octanoate + N-Pentanol at 25°C - Part 2. Solubilization of Pentanol J.B. Rosenholm and P. Stenius	755
Dissolution and Micellization of Long-Chain Alkylsulfonic Acids and Their Sodium Salts in Water M. Saito, Y. Moroi and R. Matuura	771
The Effect of Cosolvents on the Formation of Micelles of Cetyltrimethylammonium Bromide in Aqueous Solutions L. G. Ionescu, L. S. Romanesco and F. Nome	789
The Sphere to Rod Transition of CPX and CTAX Micelles in High Ionic Strength Aqueous Solutions: The Specificity of Counterions G. Porte and J. Appell	805
Salt-Induced Sphere-Rod Transition of Ionic Micelles S. Ikeda	825

Quasielastic Light Scattering Studies of the Micelle to Vesicle Transition in Aqueous Solutions of Bile Salt and Lecithin P. Schurtenberger, N. A. Mazer, W. Känzig and R. Preisig	841
The Applicability of Micellar Models to the Activity Coefficients of Sodium Carboxylates in Aqueous Solution G. Douhéret and A. Viillard	857
Kinetic Applications of Bile Salt Amphiphiles C. J. O'Connor, R. G. Wallace and B. T. Ch'ng	875
Electrostatics of Micellar Systems J. Frahm and S. Diekmann	897

PART IV. SOLUBILIZATION

Solubilization Equilibria Studied by the FT-PGSE-NMR Multicomponent Self-Diffusion Technique P. Stilbs	917
Selective Solubilization in Aqueous Surfactant Solutions R. Nagarajan and E. Ruckenstein	923
Thermodynamics and Mechanisms of Solubilization of Alcohols in Aqueous Ionic Surfactant Systems H. Høiland, O. Kvammen, S. Backlund and K. Rundt	949
Solubilization of Phenothiazine and its N-Alkyl Derivatives into Anionic Surfactant Micelles Y. Moroi, K. Satō, H. Noma and R. Matuura	963
Cholesterol Solubilization and Supersaturation in Bile: Dependence on Total Lipid Concentration and Formation of Metastable Dispersions D. Lichtenberg, I. Tamir, R. Cohen and Y. Peled	981
Further Investigations on the Micellar Solubilization of Biopolymers in Apolar Solvents P. Meier, V. E. Imre, M. Fleschar and P.L. Luisi	999

PART V. MICELLAR CATALYSIS AND REACTIONS
IN MICELLES

Micellar Effects on Reaction Rates and Equilibria L. S. Romsted	1015
Reversed Micellar Enzymology A. V. Levashov, Yu.L. Khmel'nitsky, N. L. Klyachko and K. Martinek	1069
Comparison of Rate Enhancements in Micellar and Nonmicellar Aggregates C. A. Bunton	1093
On the Validity of the Pseudo-Phase Model for Micellar Catalysis L. G. Ionescu and F. Nome	1107
Analysis of the Effect of Micelles and Vesicles on the Reactivity of Nucleophiles Derived from the Dissociation of Weak Acids H. Chaimovich, J. B.S. Bonilha, D. Zanette and I. M. Cuccovia	1121
Micelle-Mediated Luminescence and Chromatography L. J. Cline Love, R. Weinberger and P. Yarmchuk	1139
Micellar Effects on Kinetics and Equilibria of Electron Transfer Reactions E. Pelizzetti, E. Pramauro, D. Meisel and E. Borgarello	1159
Catalysis of Ester Hydrolysis by Functionalized Counterion Surfactants M. Gobbo, R. Fornasier and U. Tonellato	1169
Specific Micellar Effects in the Temporal Behaviour of Excited Benzophenone: Consequences upon the Polymerization Kinetics P. Jacques, D. J. Lougnot and J. P. Fouassier	1177
Quantitative Treatment for Salt Effects and Equilibria Shifts in Micellar Solutions R. Gaboriaud, G. Charbit and F. Dorion	1191
The Nickel(II)-PADA Reaction as a Solubilization Probe in Anionic Micellar Solutions J. R. Hicks and V. C. Reinsborough	1207

The Application of Surfactants in Spectrophotometric Determination of Metal Ions: The Interaction Between Cationic Surfactants and Some Organic Dyes	
L. Cermáková	1217

PART VI. ADSORPTION AND BINDING OF SURFACTANTS

Study of the Hydrophobic and the Electrostatic Interactions in Microphases Concentrated in Surfactant via Adsorption at Charged Interfaces	
D. Schuhmann, P. Vanel, E. Tronel-Peyroz and H. Raous ...	1233
Thermodynamics of Binding Cationic and Anionic Surfactants to Binary and Ternary Mixtures of Proteins	
B. K. Sadhukhan and D. K. Chattoraj	1249
An Internal Reflection Infrared Spectroscopic Study of AOT Adsorption onto Solid Surfaces	
K. McKeigue and E. Gulari	1271
Relation between Adsorption on a Metal Surface and Monolayer Formation at the Air/Water Interface from Amphiphilic Solutions	
T. Arnebrant, T. Nylander, P. A. Cuypers, P.-O. Hegg and K. Larsson	1291
Quantitative Ellipsometry of Protein Adsorption at Solid-Liquid Interfaces	
P. A. Cuypers, J. W. Corsel, M. P. Janssen, J. M. M. Kop, H. C. Hemker and W. Th. Hermens	1301
Association of Surfactants in Dilute Aqueous Solutions: Effect on Their Surface Properties	
D. Exerowa and A. Nikolov	1313
Polydisperse Non-Ionic Surfactants: Their Solution Chemistry and Effect on the Wettability of Solid Surfaces	
G. G. Warr, P. Scales, F. Grieser, J. R. Aston, D.R. Furlong and T.W. Healy	1329
Conditions of Phase Separation, Both at the Interface and in Solution. The Adsorption Isotherm and the Consequence of Critical Phenomena on the Behaviour of the System	
M. Privat and R. Bennes	1339
Carotenoid Films at the Air/Water Interface	
E. Chifu and M. Tomoaia-Cotisel	1349

Comparison of Interfacial Active Properties of Glycolipids from Microorganisms S. Lang, A. Gilbon, C. Syldatk and F. Wagner	1365
Study of the Interaction Between Surfactants and Polyacrylamide of Various Hydrolysis Degree J. Sabbadin, J. Le Moigne and J. François	1377
Studies on the Interaction of Sodium Saccharin with Alkyltrimethylammonium Bromides S. S. Davis, P. E. Bruce, P. Daniels and L. Feely	1391
Thermodynamic Studies on the Interaction Between Lysozyme and Sodium <u>n</u> -Dodecyl Sulphate in Aqueous Solutions M. N. Jones and P. Manley	1403
About the Contributors	1417
Index	xxiii

CONTENTS OF VOLUME 3

PART VII. REVERSE MICELLES

Kinetic Consequences of the Self Association Model in Reversed Micelles C. J. O'Connor and T. D. Lomax	1435
Dynamics of Reversed Micelles Z. A. Schelly	1453
Reverse Structures in a p-Nonylphenolpolyethyleneglycol (9.6 Mole Ethylene Oxide) - Water System A. Derzhanski and A. Zheliaskova	1463
Reactivity Studies in A.O.T. Reverse Micelles M. P. Pileni, J. M. Furois and B. Hickel	1471
Preparation of Colloidal Iron Boride Particles in the CTAB-n-Hexanol-Water Reversed Micellar System N. Lufimpadio, J. B. Nagy and E. G. Derouane	1483

PART VIII. MICROEMULSIONS AND REACTIONS
IN MICROEMULSIONS

Microemulsions - An Overview Th. F. Tadros	1501
The Water-in-Oil Microemulsion Phenomenon: Its Understanding and Predictability from Basic Concepts H.-F. Eicke, R. Kubik, R. Hasse and I. Zschokke	1533
Phase Behavior of Microemulsions: The Origin of the Middle Phase, of Its Chaotic Structure and of the Low Interfacial Tension E. Ruckenstein	1551

Influence of Cosurfactant Chemical Structure upon the Phase Diagram Features and Electrical Conductive Behavior of Winsor IV Type Media (So-Called Microemulsions)	
M. Clausse, J. Peyrelasse, C. Boned, J. Heil, L. Nicolas-Morgantini and A. Zradba	1583
Fluorescence Probe Study of Oil in Water Microemulsions	
R. Zana, J. Lang and P. Lianos	1627
Characterization of Microemulsion Structure Using Multi-Component Self-Diffusion Data	
B. Lindman and P. Stilbs	1651
Photon Correlation Techniques in the Investigation of Water-in-Oil Microemulsions	
J. D. Nicholson and J. H. R. Clarke	1663
Water/Oil Microemulsion Systems Studied by Positron Annihilation Techniques	
S. Millán, R. Reynoso, J. Serrano, R. López and L. A. Fucugauchi	1675
Zeta Potential and Charge Density of Microemulsion Drops from Electrophoretic Laser Light Scattering - Some Preliminary Results	
S. Qutubuddin, C. A. Miller, G. C. Berry, T. Fort, Jr. and A. Hussam	1693
Low Temperature Dielectric Properties of W/O Microemulsions and of their Highly Viscous Mesophase	
D. Senatra and C. M. C. Gambi	1709
Mutual and Self Diffusion Coefficients of Microemulsions from Spontaneous and Forced Light Scattering Techniques	
A. M. Cazabat, D. Chatenay, D. Langevin, J. Meunier and L. Leger	1729
Percolation and Critical Points in Microemulsions	
A. M. Cazabat, D. Chatenay, P. Guering, D. Langevin, J. Meunier, O. Sorba, J. Lang, R. Zana and M. Paillette	1737
Structural and Dynamic Aspects of Microemulsions	
P. D. I. Fletcher, A. M. Howe, N. M. Perrins, B. H. Robinson, C. Toprakcioglu and J. C. Dore	1745
Structure of Nonionic Microemulsions by Small Angle Neutron Scattering	
J. C. Ravey and M. Buzier	1759