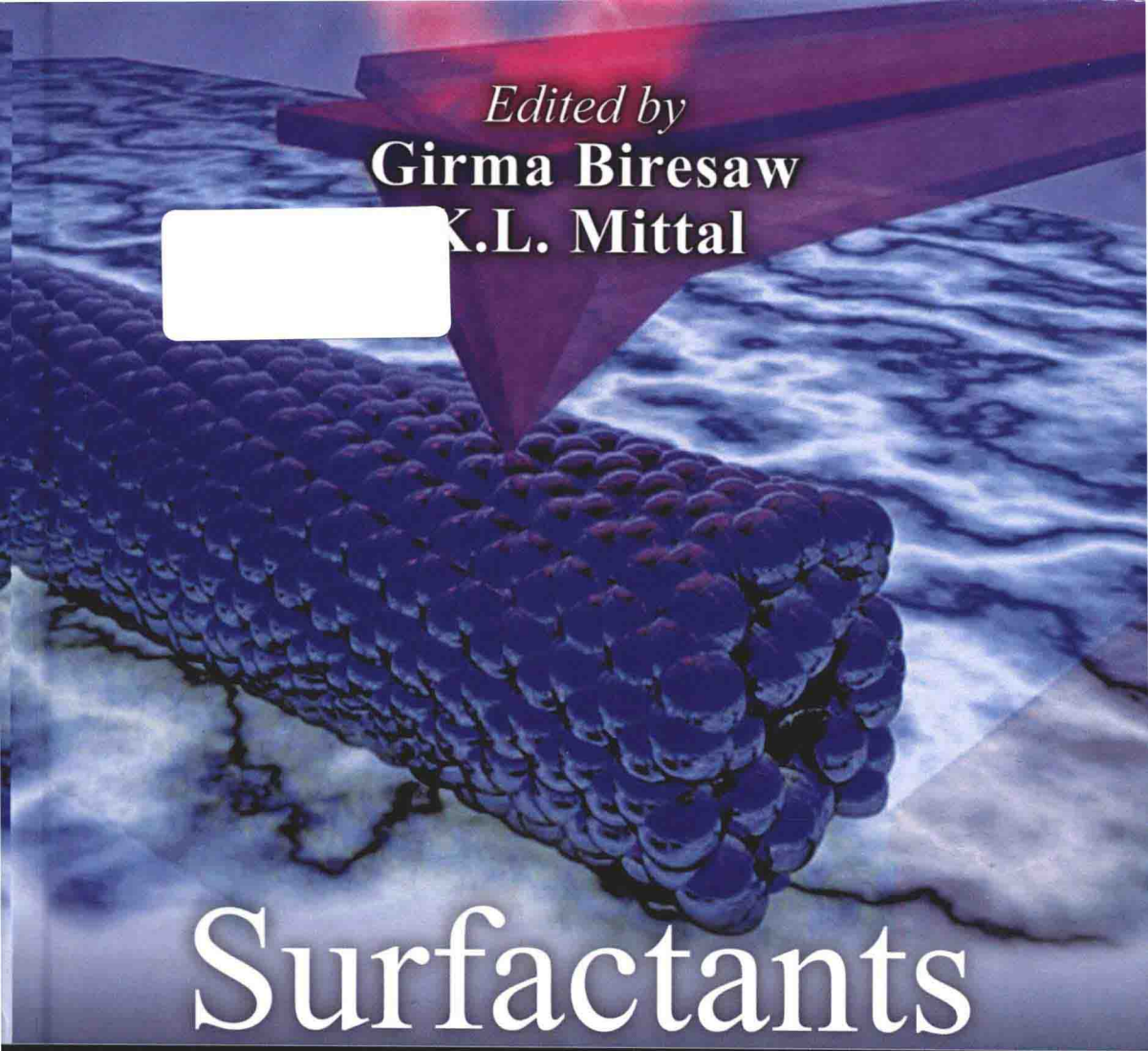

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Surfactants *in* Tribology

VOLUME 4

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Preface

Surfactants perform a wide variety of functions in tribology ranging from basic lubrication functions, such as control of friction and wear, to controlling a wide range of lubricant properties, including emulsification/demulsification, bioresistance, oxidation resistance, rust/corrosion prevention, and so on. Surfactants also spontaneously form a variety of organized structures in solution that have interesting, yet not fully understood, tribological properties. Examples of organized assemblies include monolayers, normal/reverse micelles, o/w and w/o microemulsions, hexagonal and lamellar lyotropic liquid crystals, and uni- and multilamellar vesicles. Another group of organized assemblies that have recently become of great interest in lubrication is self-assembled monolayers (SAMs), which play critical roles in the lubrication of a wide range of products, including microelectromechanical systems (MEMS) and nanoelectromechanical systems (NEMS).

There is a great deal of literature on the topics of surfactants and tribology separately. However, there is not much information on the subject of surfactants and tribology together, even though surfactants play many critical roles in tribology. In order to fill this gap in the literature linking surfactants and tribology, we organized the first symposium on "Surfactants in Tribology" as a part of the 16th International Symposium on Surfactants in Solution (SIS-2016) in Seoul, South Korea, June 4–9, 2006.

The SIS series of biennial events began in 1976 and have since been held in many corners of the globe, attended by "who's who" in the surfactant community. These meetings are recognized by the international community as the premier forum for discussing the latest research findings on surfactants in solution. In keeping with the SIS tradition, leading researchers from around the world engaged in unraveling the importance and relevance of surfactants in tribological phenomena were invited to present their latest findings at the premier "Surfactants in Tribology" symposium. The symposium was such a huge success that we decided to invite leading scientists working in this area, who may or may not have participated in the symposium, to submit written accounts (chapters) of their recent research findings in this field, which culminated in the publication of the first book *Surfactants in Tribology* in 2008.

Since the first symposium, interest has continued to grow among scientists and engineers working in the areas of both surfactants and tribology. So we decided to organize follow-up symposia on this subject at subsequent SIS meetings. Concomitantly, "Surfactants in Tribology" symposia were held during SIS-2008 (Berlin, Germany, August 17–22, 2008); SIS-2010 (Melbourne, Australia, November 14–19, 2010), and SIS-2012 (Edmonton, Canada, June 24–28, 2012). Each of these symposia has been followed by the publication of the next volume in the series *Surfactants in Tribology*, Vols., 2, 3, and 4, respectively.

Volume 4 (the current volume) comprises a total of 18 chapters dealing with various aspects of surfactants and tribology, some of which had not been covered at all in previous volumes in this series. These 18 chapters have been logically grouped into five theme areas as follows. Section I consists of four chapters dealing with advanced tribological concepts. Topics covered in Section I include physical mechanisms of atomic-scale friction, shear-induced anisotropic friction in a lubricated contact, macrotribology of semi-rigid polymer brushes, and application of quartz crystal microbalance technology in tribological investigation. Section II consists of four chapters dealing with nanotribological aspects. Topics discussed in Section II include tribology on superhydrophobic nanostructured surfaces, design and properties of self-assembled ordered films, surfactant influence on stability and lubrication of metal nanoparticle suspensions, and progress toward improved lubrication using ionic liquid lubricants. Section III comprises three chapters dealing with ionic liquids and aqueous surfactant assemblies. Topics discussed in Section III include effects of mixing ionic liquids on tribological behavior of bearing steel, aqueous solutions of surfactants in materials engineering of tribological systems, and use of surfactants in metal cutting fluids formation. Section IV deals with high-demanding applications. Topics discussed in Section IV include automotive lubricant friction modifiers, nonionic surfactants in drilling muds, surfactant effect on tribological properties of water-based petroleum drilling fluids, and role of gemini cationic surfactants in inhibiting corrosion of carbon steel. Section V deals with biobased lubricants and fluids. Topics discussed in Section V include soy-based polymeric surfactant structure influence on surface properties, biobased lubricants and functional products from cuphea oil, and biodiesel lubricity and other properties.

Surface science and tribology play very critical roles in many industries. Manufacture and use of almost all consumer and industrial products rely on the application of advanced surface and tribological knowledge. Examples of major economic sectors that rely on these two disciplines include mining, agriculture, manufacturing (metals, plastics, wood, automotive, computers, MEMS, NEMS, appliances, planes, rails, etc.); construction (homes, roads, bridges, etc.), transportation (cars, boats, rails, airplanes); and medicine (instruments and diagnostic devices, and transplants for knee, hips, and other body parts). The chapters in *Surfactants in Tribology*, Volume 4 discuss some of the underlying tribological and surface science issues relevant to many situations in diverse industries. We believe that the information compiled in this book will be a valuable resource to scientists and technologists working or entering in the fields of tribology and surface science.

This volume and its predecessors (Volumes 1–3) contain bountiful information and reflect the latest developments highlighting the relevance of surfactants in various tribological phenomena pertaining to many different situations. As we learn more about the connection between surfactants and tribology, new and improved ways to control lubrication, friction, and wear utilizing surfactants will emerge.

Now it is our pleasant task to thank all those who helped in materializing this book. First and foremost, we are very thankful to the contributors for their interest,

enthusiasm, and cooperation as well as for sharing their findings, without which this book would not have been possible. Also we would like to extend our appreciation to Barbara Glunn (Taylor & Francis) for her steadfast interest in and unwavering support for this book project and the staff at Taylor & Francis for giving this book a body form.

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Editors

Girma Biresaw earned a PhD in physical–organic chemistry from the University of California, Davis, and spent 4 years as a postdoctoral research fellow at the University of California, Santa Barbara, investigating reaction kinetics and products in surfactant-based organized assemblies. He then joined the Aluminum Company of America as a scientist and conducted research in tribology, surface/colloid science, and adhesion for 12 years. He joined the Agricultural Research Service (ARS) of the U.S. Department of Agriculture in Peoria, Illinois, in 1998 as a research chemist, and became a lead scientist in 2002. At ARS, he conducts research in tribology, adhesion, and surface/colloid science in support of programs aimed at developing biobased products from farm-based raw materials. He has received more than 150 national and international invitations, including requests to participate in and/or conduct training workshops, advisory, and consulting activities. He is a fellow of the Society of Tribologists and Lubrication Engineers, and a member of the editorial board of the *Journal of Biobased Materials and Bioenergy*. Dr. Biresaw has authored/coauthored more than 250 invited and contributed scientific publications, including more than 70 peer-reviewed articles, 6 patents, 5 edited books, more than 40 proceedings and book chapters, and more than 130 scientific abstracts.

K.L. Mittal earned his PhD from the University of Southern California in 1970 and was associated with IBM Corp. from 1972 to 1994. He is currently teaching and consulting worldwide in the areas of adhesion and surface cleaning. He is the editor of 112 published books, as well as others that are in the process of publication, within the realms of surface and colloid science and of adhesion. He has received many awards and honors and is listed in many biographical reference works. Dr. Mittal was a founding editor of the *Journal of Adhesion Science and Technology* and was its editor-in-chief until April 2012. He has served on the editorial boards of a number of scientific and technical journals. He was recognized for his contributions and accomplishments by the international adhesion community that organized the First International Congress on Adhesion Science and Technology in Amsterdam in 1995 on the occasion of his 50th birthday (235 papers from 38 countries were presented). In 2002, he was honored by the global surfactant community, which instituted the Kash Mittal Award in the surfactant field in his honor. In 2003 he was honored by the Maria Curie-Sklodowska University, Lublin, Poland, which awarded him the title of doctor *honoris causa*. In 2010, he was honored by both adhesion and surfactant communities on the occasion of publication of his 100th edited book. More recently, he initiated a new journal titled *Reviews of Adhesion and Adhesives*.

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