Tribology And Mechanics Of Magnetic Storage Devices

This series reports on the latest research from around the world in electromechanical, materials science, design, and manufacturing problems of magnetic and optical information storage devices and systems. These 35 papers cover various aspects of the magnetic information storage industry in these areas: overview of information storage technology; tribology and mechanics of flexible magnetic media, tribology and mechanics of magnetic rigid disks; dynamics and control of magnetic rigid disks; and thermo-fluid mechanics problems in magnetic rigid disks.

Much research has been carried out and a lot of progress has been made towards the use of composite materials in a wide field of tribological applications. In recent years studies have been made to determine to what degree phenomena governing the tribological performance of composites can be generalized and to consolidate interdisciplinary information for polymer-, metal- and ceramic matrix composites. The importance of promoting better knowledge in the areas of friction, lubrication and wear, in general, is demonstrated by the contents of this volume. It covers a wide range of subjects extending from fundamental research on the tribological characteristics of various multi-phase materials up to final applications of composites in wear loaded, technical components. Besides the emphasis on composites tribology, the great practical aspect of the field in many industrial applications is also reviewed by authors who are engaged in applied research as well as those in more academic activities. The articles in this volume will facilitate both researchers and mechanical designers in their work towards a set of predictive, materials engineering-related models for a more reliable use of composites as tribo-materials. Through the study of, and observation of, the tribology of sensibly formulated composite systems may emerge a clear and more profound understanding of the subject of tribology. In this sense, this book offers a major and critical evaluation of the state of understanding of the principles of tribology and its ability to serve the practical and commercial needs of this technology generally, and particularly in the context of composite systems.

This book highlights some of the most important structural, chemical, mechanical and tribological characteristics of DLC films. It is particularly dedicated to the fundamental tribological issues that impact the performance and durability of these coatings. The book provides reliable and up-to-date information on available industrial DLC coatings and includes clear definitions and descriptions of various DLC films and their properties.

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Volume III extends this handbook series to cover new developments and topics in tribology that have occurred during the past decade. It includes in-depth discussions on revolutionary magnetic bearings used in demanding applications in compressors, high-speed spindles, and aerospace equipment. Extensive coverage is given to tribology developments in office machines and in magnetic storage systems for computers. Monitoring sensors are addressed in the first chapter, followed by chapters on specific monitoring techniques for automobiles, diesels, and rotating machines. One chapter is devoted to procedures used for tracking the remaining life of lubricants. Synthetic lubricants are discussed by outstanding specialists in this rapidly developing field. Synthetics are increasingly important in widely diverse areas, including compressors using the new ozone-layer-friendly refrigerants and a variety of extreme-temperature and environmentally-sensitive applications. Water- and gas-lubricated bearings are given similar attention. The contributors also develop a new, unified coverage for fatigue life of ball and roller bearings; for design and application of porous metal bearings; for self-contained lubrication, involving oil rings, disks, and wicks; and for plastic bearings. Each of these classes of bearings are used by the millions daily throughout industry. The three-volume handbook is an essential reference to tribologists and lubrication, mechanical, and automotive engineers. It is invaluable to lubricant suppliers; bearing companies; those working in the aerospace industry; and anyone concerned with machine design, machinery wear, and maintenance.

Recent research has led to a deeper understanding of the nature and consequences of interactions between materials on an atomic scale. The results have resonated throughout the field of tribology. For example, new applications require detailed understanding of the tribological process on macro- and microscales and new knowledge guides the rational

This collection of fully peer-reviewed papers were presented at the 26th Leeds-Lyon Tribology Symposium which was held in Leeds, UK, 14-17 September, 1999. The Leeds-Lyon Symposia on Tribology were launched in 1974, and the large number of references to original work published in the Proceedings over many years confirms the quality of the published papers. It also indicates that the volumes have served their purpose and become a recognised feature of the tribological literature. This year's title is 'Thinning Films and Tribological Interfaces', and the papers cover practical applications of tribological solutions in a wide range of situations. The evolution of a full peer review process has been evident for a number of years. An important feature of the Leeds-Lyon Symposia is the presentation of current research findings. This remains an essential feature of the meetings, but for the 26th Symposium authors were invited to submit their papers for review a few weeks in advance of the Symposium. This provided an opportunity to discuss recommendations for modifications with the authors.

This second edition of Handbook of Micro/Nanotribology addresses the rapid evolution within this field, serving as a reference for the novice and the expert alike. Two parts divide this handbook: Part I covers basic studies, and Part II addresses design, construction, and applications to magnetic storage devices and MEMS. Discussions include: surface physics and methods for physically and chemically characterizing solid surfaces roughness characterization and static contact models using fractal analysis sliding at the interface and friction on an atomic scale scratching and wear as a result of sliding nanofabrication/nanomachining as well as nano/picoindentation lubricants for minimizing friction and wear surface forces and microrheology of thin liquid films measurement of nanomechanical properties of surfaces and thin films atomic-scale simulations of interfacial phenomena micro/nanotribology and micro/nanomechanics of magnetic storage devices This comprehensive book contains 16 chapters contributed by more than 20 international researchers. In each chapter, the presentation starts with macroconcepts and then lead to microconcepts. With more than 500 illustrations and 50 tables, Handbook of Micro/Nanotribology covers the range of relevant topics, including characterization of solid surfaces, measurement techniques and applications, and theoretical modeling of interfaces. What's New in the Second Edition? New chapters on: AFM instrumentation Surface forces and adhesion Design and construction of magnetic storage devices Microdynamical devices and systems Mechanical properties of materials in microstructure Micro/nanotribology and micro/nanomechanics of MEMS devices

This volume serves as a timely, practical introduction to the principles of nanotribology and nanomechanics and applications to magnetic storage systems and MEMS/NEMS. Assuming some familiarity with macrotribology/mechanics, the book comprises chapters by internationally recognized experts, who integrate knowledge of the field from the mechanics and materials-science

perspectives. Graduate students, research workers, and practicing engineers will find the book of value.

The word tribology was fIrst reported in a landmark report by P. Jost in 1966 (Lubrication (Tribology)--A Report on the Present Position and Industry's Needs, Department of Education and Science, HMSO, London). Tribology is the science and technology of two interacting surfaces in relative motion and of related subjects and practices. The popular equivalent is friction, wear and lubrication. The economic impact of the better understanding of tribology of two interacting surfaces in relative motion is known to be immense. Losses resulting from ignorance of tribology amount in the United States alone to about 6 percent of its GNP or about $200 billion dollars per year (1966), and approximately one-third of the world's energy resources in present' use, appear as friction in one form or another. A fundamental understanding of the tribology of the head-medium interface in magnetic recording is crucial to the future growth of the $100 billion per year information storage industry. In the emerging microelectromechanical systems (MEMS) industry, tribology is also recognized as a limiting technology. The advent of new scanning probe microscopy (SPM) techniques (starting with the invention of the scanning tunneling microscope in 1981) to measure surface topography, adhesion, friction, wear, lubricant-fIlm thickness, mechanical properties all on a micro to nanometer scale, and to image lubricant molecules and the availability of supercomputers to conduct atomic-scale simulations has led to the development of a new fIeld referred to as Microtribology, Nanotribology, or Molecular Tribology (see B. Bhushan, J. N. Israelachvili and U.

Tribology of Magnetic Storage Systems is dedicated to the modern developments in the macro- and microtribology and mechanics of magnetic storage systems. This collection of papers, previously published as Special Issues of the Proceedings of the Institution of Mechanical Engineers in the Journal of Engineering Tribology (Part J) makes recent research in this important and rapidly developing area of engineering tribology accessible to industrial and academic researchers world-wide. The need for higher and higher recording densities in the modern magnetic recording process requires that surfaces be as smooth as possible, and flying height be as small as possible, in the interaction between magnetic medium and magnetic head. This presents significant challenges to researchers and designers within the industry. New techniques in atomic force microscopy and friction force microscopy have led to the development of the science of microtribology. Studies within this field are being conducted to enhance understanding of interfacial phenomena in magnetic storage devices.

The comprehensive reference and textbook serves as a timely, practical introduction to the principles of nanotribology and nanomechanics. Assuming some familiarity with macroscopic tribology, the book comprises chapters by internationally recognized experts, who integrate knowledge of the field from the mechanics and materials-science perspectives. They cover key measurement techniques, their applications, and theoretical modelling of interfaces, each beginning their contributions with macro- and progressing to microconcepts.

When it was first published some two decades ago, the original Handbook of Lubrication and Tribology stood on technology's cutting-edge as the first comprehensive reference to assist the emerging science of tribology lubrication. Later, followed by Volume II, Theory and Design and Volume III, Monitoring, Materials, Synthetic Lubricants, and Ap

This volume presents cutting-edge research from throughout the world on the electromechanical, mechanics, materials science, design, and manufacturing problems of this burgeoning industry. Adhering to the highest editorial standards, 33 carefully chosen, peer-reviewed archival quality papers cover such broad areas of the magnetic information storage industry as: the dynamics and control of magnetic rigid disk drives, the mechanics and tribology of magnetic rigid disk drives, and the mechanics of flexible magnetic media.

Since January 1990, when the first edition ofthis first-of-a-kind book appeared, there has been much experimental and theoretical progress in the multi disciplinary subject of tribology and mechanics of magnetic storage devices. The subject has matured into a rigorous discipline, and many university tribology and mechanics courses now routinely contain material on magnetic storage devices. The major growth in the subject has been on the micro- and nanoscale aspects of tribology and mechanics. Today, most large magnetic storage industries use atomic force microscopes to image the magnetic storage components. Many companies use variations of AFMs such as friction force microscopes (FFMs) for frictional studies. These instruments have also been used for studying scratch, wear, and indentation. These studies are valuable in the fundamental understanding of interfacial phenomena. In the second edition, I have added a new chapter, Chapter 11, on micro and nanoscale aspects of tribology and mechanics of magnetic storage compo nents. This chapter presents the state of the art of the micro/nanotribology and micro/nanomechanics of magnetic storage components. In addition, typographical errors in Chapters 1 to 10 and the appendixes have been corrected. These additions update this book and make it more valuable to researchers of the subject. I am grateful to many colleagues and particularly to my students, whose work is reported in Chapter 11. I thank my wife, Sudha, who has been forbearing during the progress of the research reported in this chapter.

A fully updated version of the popular Introduction to Tribology, the second edition of this leading tribology text introduces the major developments in the understanding and interpretation of friction, wear and lubrication. Considerations of friction and wear have been fully revised to include recent analysis and data work, and friction mechanisms have been reappraised in light of current developments. In this edition, the breakthroughs in tribology at the nano- and micro- level as well as recent developments in nanotechnology and magnetic storage technologies are introduced. A new chapter on the emerging field of green tribology and biomimetics is included. Introduces the topic of tribology from a mechanical engineering, mechanics and materials science points of view Newly updated chapter covers both the underlying theory and the current applications of tribology to industry Updated write-up on nanotribology and nanotechnology and introduction of a new chapter on green tribology and biomimetics

The recent emergence and proliferation of proximal probes, e.g. SPM and AFM, and computational techniques for simulating tip-surface interactions has enabled the systematic investigation of interfacial problems on ever smaller scales, as well as created means for modifying and manipulating nanostructures. In short, they have led to the appearance of the new, interdisciplinary fields of micro/nanotribology and micro/nanomechanics. This volume serves as a timely, practical introduction to the principles of nanotribology and nanomechanics and applications to

magnetic storage systems and MEMS/NEMS. Assuming some familiarity with macrotribology/mechanics, the book comprises chapters by internationally recognized experts, who integrate knowledge of the field from the mechanics and materials-science perspectives. They cover key measurement techniques, their applications, and theoretical modelling of interfaces, each beginning their contributions with macro- and progressing to microconcepts. After reviewing the fundamental experimental and theoretical aspects in the first part, Nanotribology and Nanomechanics then treats applications. Three groups of readers are likely to find this text valuable: graduate students, research workers, and practicing engineers. It can serve as the basis for a comprehensive, one- or two-semester course in scanning probe microscopy; applied scanning probe techniques; or nanotribology/nanomechanics/nanotechnology, in departments such as mechanical engineering, materials science, and applied physics. With a Foreword by Physics Nobel Laureate Gerd Binnig Dr. Bharat Bhushan is an Ohio Eminent Scholar and The Howard D. Winbigler Professor in the Department of Mechanical Engineering, Graduate Research Faculty Advisor in the Department of Materials Science and Engineering, and the Director of the Nanotribology Laboratory for Information Storage & MEMS/NEMS (NLIM) at the Ohio State University, Columbus, Ohio. He is an internationally recognized expert of tribology and mechanics on the macro- to nanoscales, and is one of the most prolific authors. He is considered by some a pioneer of the tribology and mechanics of magnetic storage devices and a leading researcher in the fields of nanotribology and nanomechanics using scanning probe microscopy and applications to micro/nanotechnology. He is the recipient of various international fellowships including the Alexander von Humboldt Research Prize for Senior Scientists, Max Planck Foundation Research Award for Outstanding Foreign Scientists, and the Fulbright Senior Scholar Award.