

Aerosol Technology Hinds Pdf

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Aerosol Technology - William C. Hinds 1999-01-19

The #1 guide to aerosol science and technology -now better than ever Since 1982, Aerosol Technology has been the text of choice among students and professionals who need to acquire a thorough working knowledge of modern aerosol theory and applications. Now revised to reflect the considerable advances that have been made over the past seventeen years across a broad spectrum of aerosol-related application areas - from occupational hygiene and biomedical technology to microelectronics and pollution control -this new edition includes: * A chapter on bioaerosols * New sections on resuspension, transport losses, respiratory deposition models, and fractal characterization of particles * Expanded coverage of atmospheric aerosols, including background aerosols and urban aerosols * A section on the impact of aerosols on global warming and ozone depletion. Aerosol Technology, Second Edition also features dozens of new, fully worked examples drawn from a wide range of industrial and research settings, plus new chapter-end practice problems to help readers master the material quickly.

Overcoming Challenges to Develop Countermeasures Against

Aerosolized Bioterrorism Agents - National Research Council 2006-08-07

The National Institute of Allergy and Infectious Diseases (NIAID) gives the highest priority to developing countermeasures against bioterrorism agents that are highly infective when dispersed in aerosol form. Developing drugs to prevent or treat illnesses caused by bioterrorism agents requires testing their effectiveness in animals since human clinical trials would be unethical. At the request of NIAID, the National Academies conducted a study to examine how such testing could be improved. *Overcoming Challenges to Develop Countermeasures Against Aerosolized Bioterrorism Agents* provides recommendations to researchers on selecting the kinds of animal models, aerosol generators, and bioterrorism agent doses that would produce conditions that most closely mimic the disease process in humans. It also urges researchers to fully document experimental parameters in the literature so that studies can be reproduced and compared. The book recommends that all unclassified data on bioterrorism agent studies--including unclassified, unpublished data from U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID)--be published in the open literature. The book also calls on the U.S. Food and Drug Administration to improve the process by which bioterrorism countermeasures are approved based on the results of animal studies.

Air Pollution and Greenhouse Gases - Zhongchao Tan 2014-11-03

This textbook discusses engineering principles relating to air pollution and greenhouse gases (GHGs); it focuses on engineering principles and designs of related devices and equipment for air emission control for a variety of industries such as energy, chemical, and transportation industries. The book aims primarily at senior undergraduate and graduate students in mechanical, chemical and/or environmental engineering departments; it can also be used as a reference book by technical staff and design engineers who are interested in and need to have technical knowledge in air pollution and GHGs. The book is motivated by recent rapid advances in air pollution and greenhouse gas emissions and their control technologies. In addition to classic topics related to air pollution, this book is also featured with emerging topics related to air pollution and GHGs. It covers recent advances in engineering approaches to the reduction of GHG emissions including, but are not limited to, green energy technologies and carbon sequestration and storage. It also introduces an emerging topic in air pollution, which is referred to as Nano Air Pollution. It is a growing concern in air pollution, but largely missing in similar books, likely because of recent rapid advances in nanotechnology has outpaced the advances in nano air pollution control.

Evaporation and Droplet Growth in Gaseous Media - N.A. Fuchs

2013-10-22

Evaporation and Droplet Growth in Gaseous Media deals with the evaporation of droplets of liquid in gaseous media and the reverse process of droplet growth in a medium supersaturated with the vapor of the liquid. The discussion is restricted to the kinetics of evaporation and growth of droplets of pure liquids (and heat transfer to the same). Comprised of three chapters, this book first examines the quasi-stationary evaporation and growth of droplets that are motionless relative to the medium and the hydrodynamic factor is absent. The Maxwell equation, the basis of the theory of evaporation of droplets in a gaseous medium, is taken into account. The influence of the Stefan flow and the concentration change at the surface on the rate of evaporation are considered, along with the evaporation of droplets in a vessel with absorbing walls and the fall in temperature of both free evaporating droplets and supported evaporating droplets. The second chapter is devoted to the quasi-stationary evaporation of droplets in a stream of gas, that is, droplets moving relative to the medium. The last chapter focuses on non-stationary evaporation and growth of droplets that either motionless or moving relative to the medium. This monograph will be of interest to students, practitioners, and researchers in inorganic and structural chemistry.

Lidar - Claus Weitkamp 2006-06-03

Written by leading experts in optical radar, or lidar, this book brings all the recent practices up-to-date. With a Foreword by one of the founding fathers in the area. Its broad cross-disciplinary scope should appeal to scientists ranging from the view of optical sciences to environmental engineers. Optical remote sensing has matured to become a lead method for cross-disciplinary research. This new multi-authored book reviews the state-of-the-art in a readable monograph.

Nanoparticles and Occupational Health - Andrew D. Maynard 2007-04-06

This volume, a reprint from a special issue of the Journal of Nanoparticle Research, draws on work presented at The Second International Symposium on Nanotechnology and Occupational Health, held in Minnesota in 2005. It presents an interdisciplinary approach to nanotechnology and occupational health and offers an overview of recent developments toward assessment and management of hazards and risks associated with engineered nanomaterials.

Air Pollution and Health - Jon Ayres 2006-09-15

This invaluable volume, the third in the series Air Pollution Reviews, addresses particular questions relating to air pollution and its effect on health. It deals with the impact of nasal disease on lung exposure, how pollutants are distributed within the lung, and the uncertainties with regard to defining the dose to the lung. It takes a tangential look at the lung dose by exploring the possibility of obtaining clues from occupational medicine. Toxicologically, the book examines the possible methodology for exploring how particles and their toxicity can be investigated, and looks into the cardio-toxic effects of air pollution. The effects of pollutant mixtures are compared with those of individual pollutants. In addition, the question of the importance of acid aerosols is tackled. Epidemiologically, the book deals with the problems associated with point sources as opposed to diffuse sources of air pollution, and considers whether the health effects of air pollution can be adequately quantified. These areas, though difficult, need to be addressed, in order to develop our knowledge of the health effects of air pollution. In this volume, a strong panel of authors treat the issues. They have raised questions but at the same time succeeded in solving a number of problems. Contents: The Role of the Nose in Health and Disease (R Eccles)Cardiovascular Effects of Particles (H C Routledge & J G Ayres)Point Sources of Air Pollution — Investigation of Possible Health Effects Using Small Area Methods (P Elliott)Characterisation of Airborne Particulate Matter and Related Mechanisms of Toxicity: An Experimental Approach (K Bérubé et al.)Acid Aerosols as a Health Hazard (L C Chen et al.)Testing New Particles (K Donaldson et al.)Valuing the Health Impact

of Air Pollution: Deaths, DALYs or Dollars? (A E M de Hollander & J M Melse) Readership: Government bodies, environmentalists, scientists in the field of air pollution, undergraduate and graduate students.

Good Cascade Impactor Practices, AIM and EDA for Orally Inhaled Products - Terrence P. Tougas 2013-04-10

The purpose of this publication is to introduce a new, simpler and more effective way in which to interpret pharmaceutical aerosol particle size data from orally inhaled products (OIPs). Currently, the compendial and regulatory requirements dictate the need for measurements by full resolution multi-stage cascade impactor (CI), a process that is demanding for the operator, time consuming, prone to experimental error, and challenging for method transfers from one laboratory to another. Furthermore, we shall show that the current practice of reducing information from mass-weighted aerodynamic particle size distribution (APSD) measurements through the use of CI stage groupings is not the most effective decision-making tool for OIP quality control (QC) in comparison with newly introduced, mutually-independent efficient data analysis (EDA) metrics that can be derived either from full resolution or abbreviated impactor measurements (AIM).

Atmospheric Pollution - Mark Z. Jacobson 2002-09-05
Publisher Description

Physics of Low Dimensional Systems - J.L. Morán-López 2001-05-31

This book contains contributions on some of the most important and current topics on the physics of low dimensional systems. The main emphasis is on the magnetic properties of surfaces, thin films, and atomic clusters. State-of-the-art techniques are discussed in detail. Techniques for the production and measurement of nanostructures are discussed, and pioneering contributions on the effect on health of these particles are presented. Important studies on semiconductor nanostructures are addressed as well as aerosol systems.

A Biologic Approach to Environmental Assessment and Epidemiology - Thomas J. Smith 2010-06-24

In this book, Thomas J. Smith and David Kriebel assert that important advances in the quantification of environmental risks can only come through a true synthesis of the fields of environmental epidemiology and exposure assessment. They have built a common biologic model of exposure, physiologic response, and disease, a synthesis of the various existing models which serves to both simplify and improve the application of environmental epidemiology and exposure assessment to current and future environmental chemical risks.

Clinical Handbook of Air Pollution-Related Diseases - Fabio Capello 2018-02-21

This book examines in detail the clinical implications of those diseases that either are primarily triggered by air pollution or represent direct consequences of air pollutants. The aim is to provide medical practitioners with practical solutions to issues in diagnosis and treatment while simultaneously furnishing other interested parties with crucial information on the field. The book introduces the concept that air pollution-related diseases constitute a new class of pathologies. A wide range of conditions mainly attributable to air pollution are discussed, covering different body systems and pollution impacts in subsets of the population. In addition to presenting state of the art overviews of clinical aspects, the book carefully examines the implications of current knowledge for social and public health strategies aimed at disease prevention and prophylaxis. The Clinical Handbook of Air Pollution-Related Diseases will greatly assist doctors and healthcare workers when dealing with the consequences of air pollution in their everyday practice and will provide researchers, industry, and policymakers with valuable facts and insights.

Particle Filter Retrofit for All Diesel Engines - Andreas Mayer 2008

Aerosol Science and Technology - Parker C. Reist 1993

Introduction to Aerosol Science - Parker C. Reist 1984

A Framework for Assessing the Health Hazard Posed by Bioaerosols - National Research Council 2008-11-30

Biological warfare agent (BWA) detectors are designed to provide alerts to military personnel of the presence of dangerous biological agents. Detecting such agents promptly makes it possible to minimize contamination and personnel exposure and initiate early treatment. It is also important, though, that detectors not raise an alarm when the situation does not warrant it. The question considered in this book is whether Agent-Containing Particles per Liter of Air (ACPLA) is an appropriate unit of measure for use in the evaluation of aerosol detectors

and whether a better, alternative measure can be developed. The book finds that ACPLA alone cannot determine whether a health threat exists. In order to be useful and comparable across all biological agents and detection systems, measurements must ultimately be related to health hazard. A Framework for Assessing the Health Hazard Posed by Bioaerosols outlines the possibility of a more complex, but more useful measurement framework that makes it possible to evaluate relative hazard by including agent identity and activity, particle size, and infectious dose.

[Airborne Particles](#) - National Research Council (U.S.). Subcommittee on Airborne Particles 1979

Principles of Environmental Physics - John Monteith 1990-02-15

Thoroughly revised and up-dated edition of a highly successful textbook.

Review of the Department of Defense Enhanced Particulate Matter Surveillance Program Report - National Research Council 2010-08-23

Soldiers deployed during the 1991 Persian Gulf War were exposed to high concentrations of particulate matter (PM) and other airborne pollutants. Their exposures were largely the result of daily windblown dust, dust storms, and smoke from oil fires. On returning from deployment, many veterans complained of persistent respiratory symptoms. With the renewed activity in the Middle East over the last few years, deployed military personnel are again exposed to dust storms and daily windblown dust in addition to other types of PM, such as diesel exhaust and particles from open-pit burning. On the basis of the high concentrations observed and concerns about the potential health effects, DOD designed and implemented a study to characterize and quantify the PM in the ambient environment at 15 sites in the Middle East. The endeavor is known as the DOD Enhanced Particulate Matter Surveillance Program (EPMSP). The U.S. Army asked the National Research Council to review the EPMSP report. In response, the present evaluation considers the potential acute and chronic health implications on the basis of information presented in the report. It also considers epidemiologic and health-surveillance data collected by the USACHPPM, to assess potential health implications for deployed personnel, and recommends methods for reducing or characterizing health risks.

Aerosol Science and Technology - David S. Ensor 2011-10-06

Aerosol Science and Technology: History and Reviews captures an exciting slice of history in the evolution of aerosol science. It presents in-depth biographies of four leading international aerosol researchers and highlights pivotal research institutions in New York, Minnesota, and Austria. One collection of chapters reflects on the legacy of the Pasadena smog experiment, while another presents a fascinating overview of military applications and nuclear aerosols. Finally, prominent researchers offer detailed reviews of aerosol measurement, processes, experiments, and technology that changed the face of aerosol science. This volume is the third in a series and is supported by the American Association for Aerosol Research (AAAR) History Working Group, whose goal is to produce archival books from its symposiums on the history of aerosol science to ensure a lasting record. It is based on papers presented at the Third Aerosol History Symposium on September 8 and 9, 2006, in St. Paul, Minnesota, USA.

[Aerosols Handbook](#) - Lev S. Ruzer 2004-12-28

As more attention is dedicated to understanding the occupational health risks associated with the industrial manufacture and use of nanotechnology, *Aerosols Handbook: Measurement, Dosimetry, and Health Effects* is a timely presentation of time-tested research in the field of aerosol science. The book covers a multitude of topics in indoor, outdoor,

[Aerosol Measurement](#) - Pramod Kulkarni 2011-09-09

Aerosol Measurement: Principles, Techniques, and Applications Third Edition is the most detailed treatment available of the latest aerosol measurement methods. Drawing on the know-how of numerous expert contributors; it provides a solid grasp of measurement fundamentals and practices a wide variety of aerosol applications. This new edition is updated to address new and developing applications of aerosol measurement, including applications in environmental health, atmospheric science, climate change, air pollution, public health, nanotechnology, particle and powder technology, pharmaceutical research and development, clean room technology (integrated circuit manufacture), and nuclear waste management.

[Fluid Dynamics and Transport of Droplets and Sprays](#) - W. A. Sirignano 2010-01-11

This book discusses the theoretical foundations of spray and droplet

applications relevant to the technology for active control of sprays applied to new products and applications, improved product performance, cost reductions, and improved environmental outcomes. It also covers theory related to power and propulsion; materials processing and manufacturing technologies including droplet-based net form processing, coating, and painting; medication; pesticides and insecticides; and other consumer uses.

Optics of the Atmosphere - Earl J. McCartney 1976

Air Pollution - Bhola R. Gurjar 2010-06-22

Air pollution is recognized as one of the leading contributors to the global environmental burden of disease, even in countries with relatively low concentrations of air pollution. *Air Pollution: Health and Environmental Impacts* examines the effect of this complex problem on human health and the environment in different settings around the world. I

Criminal Behavior: Pearson New International Edition - Curt R. Bartol 2014

For undergraduate and graduate courses in criminal behavior, criminology, the psychology of crime, crime and delinquency, and forensic psychology. A comprehensive psychological approach to criminal behavior. Accurate, researched-based, contemporary, and comprehensive: *Criminal Behavior: A Psychological Approach*, Tenth Edition, builds on the excellence established in previous editions. The text offers a detailed look at crime, what may lead to it, and how criminal behavior may be prevented, all from a psychological perspective. Focusing on serious crimes, particularly those involving violence, *Criminal Behavior* offers a comprehensive look at this complex field with effective and engaging material that has been classroom-tested for over thirty years.

Sea Salt Aerosol Production - Ernie R. Lewis 2004-01-09

Published by the American Geophysical Union as part of the Geophysical Monograph Series, Volume 152. Sea salt aerosol (SSA) exerts a major influence over a broad reach of geophysics. It is important to the physics and chemistry of the marine atmosphere and to marine geochemistry and biogeochemistry generally. It affects visibility, remote sensing, atmospheric chemistry, and air quality. Sea salt aerosol particles interact with other atmospheric gaseous and aerosol constituents by acting as sinks for condensable gases and suppressing new particle formation, thus influencing the size distribution of these other aerosols and more broadly influencing the geochemical cycles of substances with which they interact. As the key aerosol constituent over much of Earth's surface at present, and all the more so in pre-industrial times, SSA is central to description of Earth's aerosol burden.

Pharmaceutical Inhalation Aerosol Technology, Second Edition - Anthony J. Hickey 2003-09-03

This thoroughly revised and expanded reference provides authoritative discussions on the physiologic, pharmacologic, metabolic, molecular, cellular and physicochemical factors, influencing the efficacy and utilization of pharmaceutical aerosol. It analyzes the latest science and developments in the generation, administration and characterization of these compounds, showcasing current clinical applications, the efficiency and limitations of major aerosol products and emerging aerosol therapies impacting the field.

Introduction to Robotics - Saeed B. Niku 2010-09-22

Niku offers comprehensive, yet concise coverage of robotics that will appeal to engineers. Robotic applications are drawn from a wide variety of fields. Emphasis is placed on design along with analysis and modeling. Kinematics and dynamics are covered extensively in an accessible style. Vision systems are discussed in detail, which is a cutting-edge area in robotics. Engineers will also find a running design project that reinforces the concepts by having them apply what they've learned.

Fibrous Filter Media - Philip Brown 2017-06-16

Fibrous Filter Media comprehensively covers the types, manufacture, applications, performance, and modeling of fibrous filter media. Part I introduces the principles of gas and liquid filtration, while Part II presents an overview of the types of fibrous filters, including details of fiber types, fabric construction, and applications. Part III covers a variety of filtration applications in which fibrous assemblies are used, with examples ranging from filtration for improving air quality, to medical filters, to industrial waste-water filtration. Finally, Part III covers the properties and performance of fibrous filters, including chapters on filter performance and simulation. With its expert editors and international team of contributors, this important book provides information on fibrous filters relevant to fiber and textile scientists, and is also ideal for

academics and industry professionals working in the field of filtration. Dr. Philip Brown is Sweetenburgh Professor of polymer and textile engineering at Clemson University, USA. Dr. Christopher Cox is Professor of mathematical sciences at Clemson University, USA. Systematic and comprehensive coverage of the trends and new technologies being developed in the field of fibrous filter media Focused on the needs of the textiles and filtration industries, with a clear emphasis on applied technology Contains contributions from an international team of authors edited by an expert in the field
Aerosol Science - Ian Colbeck 2014-01-30

Aerosols influence many areas of our daily life. They are at the core of environmental problems such as global warming, photochemical smog and poor air quality. They can also have diverse effects on human health, where exposure occurs in both outdoor and indoor environments. However, aerosols can have beneficial effects too; the delivery of drugs to the lungs, the delivery of fuels for combustion and the production of nanomaterials all rely on aerosols. Advances in particle measurement technologies have made it possible to take advantage of rapid changes in both particle size and concentration. Likewise, aerosols can now be produced in a controlled fashion. Reviewing many technological applications together with the current scientific status of aerosol modelling and measurements, this book includes: • Satellite aerosol remote sensing • The effects of aerosols on climate change • Air pollution and health • Pharmaceutical aerosols and pulmonary drug delivery • Bioaerosols and hospital infections • Particle emissions from vehicles • The safety of emerging nanomaterials • Radioactive aerosols: tracers of atmospheric processes With the importance of this topic brought to the public's attention after the eruption of the Icelandic volcano Eyjafjallajökull, this book provides a timely, concise and accessible overview of the many facets of aerosol science.

Aerosols and Climate - Ken S. Carslaw 2022-08-22

The ever-diversifying field of aerosol effects on climate is comprehensively presented here, describing the strong connection between fundamental research and model applications in a way that will allow both experienced researchers and those new to the field to gain an understanding of a wide range of topics. The material is consistently presented at three levels for each topic: (i) an accessible "quick read" of the essentials, (ii) a more detailed description, and (iii) a section dedicated to how the processes are handled in models. The modelling section in each chapter summarizes the current level of knowledge and what the gaps in this understanding mean for the effects of aerosols on climate, enabling readers to quickly understand how new research fits into established knowledge. Definitions, case studies, reference data, and examples are included throughout. *Aerosols and Climate* is a vital resource for graduate students, postdoctoral researchers, senior researchers, and lecturers in departments of atmospheric science, meteorology, engineering, and environment. It will also be of interest to those working in operational centers and policy-facing organizations, providing strong reference material on the current state of knowledge. Includes a section in each chapter that focuses on the treatment of relevant aerosol processes in climate models Provides clear exposition of the challenges in understanding and reducing persistent gaps in knowledge and uncertainties in the field of aerosol-climate interaction, going beyond the fundamentals and existing knowledge Authored by experts in modeling and aerosol processes, analysis or observations to ensure accessibility and balance

WMO/GAW Aerosol Measurement Procedures - 2016

"This report expands the guidelines on aerosol measurements from AOD to include a comprehensive list of aerosol optical, physical and chemical measurements that are needed globally. It provides assistance to those involved in developing an integrated global aerosol measurement system for climate and atmospheric composition studies"--Provided by publisher.

Inhalation Aerosols - Anthony J. Hickey 2019-03-21

Inhalation aerosols continue to be the basis for successful lung therapy for several diseases, with therapeutic strategies and the range of technology significantly evolving in recent years. In response, this third edition takes a new approach to reflect the close integration of technology with its application. After briefly presenting the general considerations that apply to aerosol inhalation, the central section of the book uses the focus on disease and therapeutic agents to illustrate the application of specific technologies. The final integrated strategies section draws the major points from the applications for disease targets and drug products.

First Principles of Meteorology and Air Pollution - Mihalis Lazaridis 2010-11-18

This book's main objective is to decipher for the reader the main processes in the atmosphere and the quantification of air pollution effects on humans and the environment, through first principles of meteorology and modelling/measurement approaches. The understanding of the complex sequence of events, starting from the emission of air pollutants into the atmosphere to the human health effects as the final event, is necessary for the prognosis of potential risk to humans from specific chemical compounds and mixtures of them. It fills a gap in the literature by providing a solid grounding in the first principles of meteorology and air pollution, making it particularly useful for undergraduate students. Its broad scope makes it a valuable text in many related disciplines, containing a comprehensive and integrated methodology to study the first principles of air pollution, meteorology, indoor air pollution, and human exposure. Problem-solving exercises help to reinforce concepts.

Methods in Pulmonary Research - Stefan Uhlig 2012-12-06

"Methods in Pulmonary Research" presents a comprehensive review of methods used to study physiology and the cell biology of the lung. The book covers the entire range of techniques from those that require cell cultures to those using in vivo experimental models. Up-to-date techniques such as intravital microscopy are presented. Yet standard methods such as classical short circuit techniques used to study tracheal transport are fully covered. This book will be extremely useful for all who work in pulmonary research, yet need a practical guide to incorporate other established methods into their research programs. Thus the book will prove to be a valuable resource for cell biologists who wish to use organs in their research programs as well biological scientists who are moving their research programs into more cell related phenomena.

Aerosols - Igor Agranovski 2011-05-16

This self-contained handbook and ready reference examines aerosol science and technology in depth, providing a detailed insight into this progressive field. As such, it covers fundamental concepts, experimental methods, and a wide variety of applications, ranging from aerosol filtration to biological aerosols, and from the synthesis of carbon nanotubes to aerosol reactors. Written by a host of internationally renowned experts in the field, this is an essential resource for chemists and engineers in the chemical and materials disciplines across multiple

industries, as well as ideal supplementary reading in graduate level courses.

Measurement, Analysis and Remediation of Environmental Pollutants - Tarun Gupta 2019-10-08

This book discusses contamination of water, air, and soil media. The book covers health effects of such contamination and discusses remedial measures to improve the situation. Contributions by experts provide a comprehensive discussion on the latest developments in the detection and analysis of contaminants, enabling researchers to understand the evolution of these pollutants in real time and develop more accurate source apportionment of these pollutants. The contents of this book will be of interest to researchers, professionals, and policy makers alike.

Environmental Chemistry of Aerosols - Ian Colbeck 2008-03-24

Covering the most recent material, this text brings together all the information on atmospheric aerosols in one place, making it easily accessible to practitioners and students.

Nanofiber Filter Technologies for Filtration of Submicron

Aerosols and Nanoaerosols - Wallace Woon-Fong Leung 2021-10-30

Nanofiber Filter Technologies for Filtration of Submicron Aerosols and Nanoaerosols covers nanoaerosols and larger submicron aerosols present in high abundance in our surroundings, on the order of ten thousand's per cubic centimeter of air in 26 cities. The book summarizes various new technologies that deploy nanofibers for capturing nanoaerosols and submicron aerosols, such as composite filter, multilayer nanofiber, depth-to-surface filtration with nanofiber filter, cleaning of loaded nanofiber filter by backpulse-and-backblow, single and multilayer charged nanofiber filter, and real aerosols with uncharged and charged nanofiber filter, monodispersed versus polydispersed aerosols challenging nanofiber filter, CFD in simulating depth and cake filtration, etc. Describes technologies in a simple, understandable manner Uses basic engineering principles to build-up technologies Provides examples throughout the book for making illustrations Presents figures in a clear and self-explanatory manner to convey the important points Covers when, where and how novel technologies on nanofibers filters can be implemented Includes problems and a summary at end of each chapter to help students reflect on what has been learned