Book Reviews

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1 Handbook of Composite Fabrication

by: Güneri Akovali
Published 2001 by RAPRA Technology Ltd.,
Shawbury, Shrewsbury, Shropshire, SY4 4NR, UK. 196pp.
ISBN: 1-85957-263-4

A composite, in general, is defined as a combination of two or more components differing in form or composition on a macro scale, with two or more distant phases having recognisable interfaces between them.

Proper combination of materials into composites gives rise to properties which transcend those of the constituents, as a result of the principle of combined action. Materials of biological origin are generally composites. Bone, for instance, achieves its combination of lightness and strength by combining crystals of apatite (a compound of calcium) with fibres of the protein collagen, whereas wood contains cellulose fibres surrounded by lignin and hemicelluloses. Crushed rock aggregate used in concrete produces a composite structure, which reduces the cost and helps to improve the compressive strength. Structural weight savings (while retaining the reliability and strength), are achieved for aerospace, rocket applications etc. by the use of composite materials.

Composites are produced to optimise material properties, mechanical (mainly strength), and chemical and/or physical properties. In the latter optimisation of thermal (thermal expansion/thermal conduction, specific heat, softening and melting points), electrical (electrical conductivity/electrical permittivity, dielectric loss), optical and acoustical properties can be noted. Since the early 1960s, there has been an increasing demand for materials that are stiffer and stronger, yet lighter in aeronautic, energy, civil engineering and in various structural applications. Unfortunately, no monolithic engineering material available is able to satisfy them. This need and demand certainly led to the concept of combining different materials in an integral composite structure.

Composites usually consist of a reinforcing material embedded in a matrix (binder). The effective method to increase the strength and to improve overall properties is to incorporate dispersed phases into the matrix, which can be an engineering material such as ceramic, metal or polymer. Hence, ceramic matrix composites, metal matrix composites (MMC) or polymer matrix composites (PMC) – or ceramic/metal/polymer composites –, carbon matrix composites (CMC) or even hybrid composites are obtained. In a composite, matrices, in general, are of low modulus, while reinforcing elements are typically 50 times stronger and 20–150 times stiffer. MMC and CMC structures are developed to provide rather high temperature applications, where PMC are usually inadequate. Furthermore, since metals are more conductive (electrically and thermally),

MMCs are also used in heat dissipation/electronic transmission applications. Each matrix type has a different impact on the processing technique.

The book has seven chapters. Each of these was prepared by a group of experts from different parts of the world. The first chapter, the introduction, gives some definitions and classifications with some depth on the matrices and reinforcements for all types of composite structures, including polymeric, metallic and ceramic matrix composites. More detailed information about constituent materials (matrices and reinforcements) is provided in Chapter 2. Different processing techniques of polymer composites are discussed in the following chapters, briefly: open mould (in Chapter 3) and closed mould (matched die processes, filament winding) (Chapter 4) and pultrusion (Chapter 5). The book ends with the machining and joining processes commonly used for polymer composite structures.

This book is designed as a handbook with some basic information on polymeric composite fabrication. It is prepared by considering beginners as well as technical personnel already working in this area. For this reason, it contains basic principles as well as an up-to-date information on various aspects, including applications.

2 Handbook of Polymer Blends and Composites – Volume 1
by: A.K. Kulshreshtha and C. Vasile
Published 2002 by RAPRA Technology Ltd.,
Shawbury, Shrewsbury, Shropshire, SY4 4NR, UK. 558pp.
ISBN for Volume 1: 1-85957-249-9, ISBN for complete: 1-85957-309-6

The extraordinary growth in chemical industries in the last century is in response to a growing world population, its increasing demands for more food, better healthcare, improved housing and numerous chapter and abundant consumer products. What is expected of chemical industries in the 21st century is a revolution in that the environmental and societal issues need to have an equal weighting with economic considerations. Green chemistry in its broad sense can be considered as producing chemicals and using chemistry while being aware of the environment, by reducing waste production, reducing the consumption of materials, reducing the demand for energy, reducing the use of non-renewable resources, and reducing risks, hazards and costs. The topics of this handbook try to answer these questions in a specific way by using simple rules of mixing. Polymer blending is a very useful and versatile strategy for the polymer chemist for designing new materials that potentially fulfil these new 'green' requirements.

This handbook is intended to provide an overview of the theory and practice of polymer blends and composites. It is a collection of monographs on the subject of polymer blends and composites but much remains to be done and understood. The subject is huge and the number of pages is limited. The choice of subjects has changed over the years as science and technology have progressed. The *Handbook of Polymer Blends and Composites* is in four volumes. The first two volumes are concerned with the state-of-the art of composite development, characteristics of particulate fillers and fibre reinforcements and interface characteristics, main procedures of composites manufacture and their applications. The other two volumes are dedicated to polymer blends. These volumes start with general aspects including terminology, thermodynamics of polymer mixing, peculiar behaviour of polymer blends and the progress recorded in investigation

and application of various classes of polymer blends, ending with specialty polymer blends such as silicones, liquid crystalline polymers, lignocelluloses and eco-friendly polymers blends.

Practical and theoretical investigations are presented, which are aimed at generating an understanding of the fundamental nature of polymer mixtures and composites and describing progress in the thermodynamics of mixing of binary and multi-component systems.

It has been established theoretically that most pairs of chemically different polymers are mutually immiscible and mixing usually results in materials, which are phase separated and have weak polymer-polymer interfaces, and therefore have poor mechanical properties.

Much less attention has been given in the published monograph and reviews on polymer blends to the thermodynamic properties of complex materials like gels, bio macromolecules, micelles, colloids, block copolymers and similar substances that are often called 'soft materials'. Such materials abound in nature and technology, application of chemical thermodynamics to soft materials has been delayed because of experimental difficulties and because, until recently, there were few theoretical models available for describing assemblies of complicated molecules.

Thanks to recent advances in statistical mechanics and molecular physics, and thanks to increasingly fast computers, it is now possible to develop a hard science for 'soft materials'. The creation and understanding of soft materials depend primarily on experimental science. Now statistical mechanics is able to provide guidance toward interpreting experimental results and toward reducing experimental effort. While thermodynamic models are useful for suggesting what experimental work is most likely to a successful result. An enhanced optimisation of material performance through a better understanding of the theoretical basis and development of computer simulation of all dependences between composition – miscibility-processing parameters and properties is necessary.

3 REACH 2007: Registration, Evaluation and Authorisation of Chemicals Published 2007 by RAPRA Technology, Smithers Rapra Ltd., Shawbury, Shrewsbury, Shropshire, SY4 4NR, UK. 252pp. ISBN: 978-1-84735-014-5

REACH stands for the Registration, Evaluation and Authorisation of Chemicals. In fact, there is a further stage, restriction, which certain substances will also have to go through. REACH is estimated to apply to approximately 30,000 substances already on the market and new substances as they are used by industry.

Companies that manufacture or import substances caught by REACH in quarter than 1 tonne per year, must register with a new chemicals agency. Failure to comply will mean exclusion from the EU market. Other data obligations fall on companies further down the supply chain, but consumers have no obligations under REACH. Registration requires detailed technical dossiers to be compiled (requirements increase with tonnage and hazardous nature). Some dossiers will be evaluated and the Agency may decide additional testing is needed. Substances classed as being of 'very high concern' will be reviewed and must go through substances include

those that are carcinogenic/mutagenic/toxic to reproduction (CMRs), or persistent/bloaccumulative/toxic (PBTs), or have similar hazards (such as endocrine disrupting chemicals). Authorisation will only be granted if the relevant risks can be adequately controlled. The Agency may also impose restrictions or ban the use of certain substances.

The overall aim of REACH is to cover all substances that are on the market, so that there is a level playing field for substances. REACH covers those substances that have been around for many years which may not be subject to much regulation, and new substances that must undergo much more stringent testing procedures.

Fundamentally, REACH applies to substances rather than products: the substances can be on their own: within mixtures of other substances known as 'preparations'; or within more complex 'articles'. The actual products on the market that come under REACH may fall within all of these categories, but are most likely to be within the definition of a preparation or an article. For example, a bottle of engine oil could be made up of a plastic bottle, described as an article, and the oil inside it could be classed as a preparation. Therefore, companies will need to assess how the products they make/use fit within the requirements of REACH. In general terms, substances in preparations must be registered, but substances in articles do not need to be registered unless they are intended to be released under reasonably foreseeable conditions of use (and the tonnage levels are met). Determining what may constitute such 'reasonably foreseeable conditions of use' should be straightforward in a number of cases but in other cases this issue will be more complex to determine.

Under REACH obligations fall upon three main classes of entity: manufacturers, importers, and downstream users. It is fairly straightforward who is a manufacturer or importer. A downstream user is less intuitive and is defined as a professional user of substances who buys from a manufacturer/importer but is not a distributor/retailer or consumer. The main obligations are on manufacturers and importers, but downstream users and distributors also have to comply with various data requirements, which are examined in more detail below. There is no definition of producer/retailer in REACH, but retailers will still be affected if, for example, product formulations change or products stop being produced.

In practice, this means that companies should be thinking about the relationship they have with companies in their supply chain. In particular, whether there are any weak areas in supply agreements where obligations are unclear, and whether it is necessary to revisit or redefine requirements. Top this end, contractual supply arrangements may need to be legally revised. Companies may also want to consider certification requirements for suppliers.

4 Additive Migration from Plastics into Foods: A Guide for Analytical Chemists by: T.R. Crompton Published 2007 by RAPRA Technology Limited, Shawbury, Shrewsbury, Shropshire, SY4 4NR, UK. 324pp. ISBN: 978-1-84735-014-5

Plastics are now being used on a large scale for the packaging of fatty and aqueous foodstuffs and beverages, both alcoholic and non-alcoholic.

Contact between plastics packaged commodities also occurs in the products of the pharmaceutical and cosmetics industries and similar considerations apply to these where direct contact occurs between the packed commodity and the container, this is likely that some transfer will occur of polymer additives, adventitious impurities such as monomers, oligomers, catalyst remnants and residual polymerisation solvents and of low molecular weight polymer fractions from the plastic into the packaged material with the consequent risk of a toxic hazard to the consumer. The actual hazard arising to the consumer from any extractable material is a function of two properties, namely, the intrinsic toxicity of the extracted material as evaluated in animal feeding trials and the amount of extracted from the polymer which enters the packed commodity under service conditions.

In the book the following chapters are included:

- Additive migration from plastics into package commodition
- Types a polymers used in commodity packaging
- Non-polymeric components of plastics
- Determination of antioxidants
- Determination of ultraviolet stabilisers in extractants
- Determination of plasticisers in extractants
- Determination of originations thermal stabilisers in extractants
- Determination of lubricants in extraction liquids
- Determination of monomers and oligamers in extractants
- Analysis of polymer extraction liquids containing more than one migrant
- Determination of additives and their breakdown products in extractants
- Additive migration theory
- Gas barrier properties of food plastic film
- Legislative aspect of the use of additives in packaging plastics.

The analysis of aqueous or fatty foods, beverages, food stimulant liquids, pharmaceuticals and cosmetics which have been contacted with plastics either in extraction tests or during the shelf life of a packaged commodity presents many fascinating and all too difficult analytical problems. Thus, the substance to be determined usually occurs at extremely low concentrations and in complex matrix and several extracted substances may be present in the extraction liquid with mutually interfering effects on the analysis.

The introduction of tailored polymer-based structures as packaging materials for foodstuffs has been increasing over the last decades. The main commercial appeal of the materials lies in their ability to offer a broad variety of tailor-made properties and yet to be cheap and easily processed. A large number of technologies have been put into place, i.e. multilayer structure, modified and equilibrium modified atmosphere packaging active packaging and so on.

This book will be of interest to those engaged in the implementation of packaging legislation, including management, analytical chemists and the manufacturers of foods,

beverages, pharmaceuticals and cosmetics and also scientific and toxicologists in the packaging industry.

5 Ceramics Science and Technology – Volume 1: Structures

by: R. Riedel and I. Wei Chen
Published 2008 by Wiley-WCH Verlag GmbH & Co. KGaA, Wainheim, Germany. 612pp.
ISBN: 978-3-527-31155-2

Besides metals and polymers, advanced ceramics are one of the most promising classes of materials for the key technologies of the 21st century. Recent developments in the field of ceramics include a selection of synthesis, processing and sintering techniques applied for the production of novel structural and functional ceramics and ceramic composites. Significant progress has been made in the past two decades with respect to the production of novel multifunctional ceramics with a tailor made micro- and/or nanoscale structure reflecting the increasing technological importance of advanced ceramic materials.

The contributions highlight the increasing technological significance of advanced ceramic materials and present concepts for their production and application. Volume 1 deals with structural properties of ceramics by considering a broad spectrum of length scale, starting from the atomic level by discussing amorphous and crystalline solid state structural features, and continuing with the microstructural level by commenting on microstructural design, mesoscopic, and nanostructures, glass ceramics, cellular structures, thin films and multiphase (composite) structures.

Although ceramics have been known to mankind literally for millennia, research has never ceased. Apart from the classic uses as a bulk material in pottery, construction, and decoration, the latter half of the 20th century saw an explosive growth of applications fields, such as electrical and thermal insulators, wear-resistant bearings, surface coatings, lightweight armour, or aerospace materials. In addition to plain, hard solids, modern ceramics come in many new guises such as fabrics, ultrathin films, microstructures and hybrid composites.

In the book the following chapters are included:

- Modern trends in advanced ceramics
- Structure of ceramic materials: atomic level
- Modelling amorphous ceramic structures
- Structural chemistry of ceramics
- Diffusion in ceramics
- Structures of ceramic materials: thermodynamics and constitution
- Structures of ceramic materials: microstructural level
- Microstructural design of ceramics: theory and experiment
- Mesoscopic ceramic structures in one, two, and three dimensions

- Bulk ceramic nanostructures
- Class ceramics: silica- and alumina-based
- Cellular structures
- Ceramic thin films
- Multiphase fiber composites.

Furthermore a variety of application fields are emerging in which novel ceramics are required and are expected to be established and commercialised in the near future. This technologically driven process requires a long-term alignment and a strong basis in continued fundamental research in ceramics science and technology. The four-volume series would like to contribute to this development by providing the latest knowledge in ceramics science suitable for students specialising in ceramics as well as for university and industrial research.

6 Physical Properties of Polymers
by: J. Mark et al.
Published 2004 by The Press Syndicate of the University of Cambridge, the Pitt Building, Trumpington St., Cambridge, UK; Cambridge University Press, The Edinburgh Building, Cambridge CB2 2RU, UK. 519pp.
ISBN: 0-521-82317 X, ISBN: 0-521-53018-0

The third edition of this well-known textbook discusses the diverse physical states and associated properties of polymeric materials. The contents of the book have been conveniently divided into two general parts, 'Physical states of polymers' and 'Some characterization techniques'.

This third edition, written by seven leading figures in the polymer-science community, has been thoroughly updated and expanded. As in the second edition, all of the chapters contain general introductory material and comprehensive literature citations designed to give newcomers to the field an appreciation of the subject and how it fits into the general context of polymer science.

In the book the following chapters are included:

Part I Physical states of polymers

- The rubber elastic state (James E. Mark)
- The glass transition and the glassy state (Kia L. Ngai)
- Viscoelasticity and flow in polymeric liquids (William W. Graessley)
- The crystalline state (Leo Mandelkern)
- The mesomorphic state (Edward T. Samulski).

Part II Some characterization techniques

- The application of molecular spectroscopy to characterization of polymers (Jack L. Koenig)

- Small-angle-neutron-scattering characterization of polymers (George D. Wignall).

The third edition of *Physical Properties of Polymers* provides enough core material for a one-semester survey course at the advanced undergraduate or graduate level.

7 Practical Stress Analysis in Engineering Design – edited by R. Crowson, The Handbook of Manufacturing Engineering, Planning and Instructional Methods by: R. Huston and H. Josephs

Published 2009 by CRC Taylor & Francis Group, Boca Raton, London, New York, 6000 Broken Sound Parkway NW, Suite 300, Boca Raton, Florida 33487-2742, USA. 634pp. ISBN-10: 0-8493-5550-8, ISBN-13: 978-0-8493-5550-9, ISBN: 978-1-57444-713-2

Industrialists, marketing leaders, military planners and space scientists are continually asking their engineers and designers to produce new designs for all kinds of mechanical systems. Designs that are simultaneously workable, reliable, long-lived, easy to manufacture, safe and economical are envisioned. Often, system components are required to be concurrently light in weight, strong and per fatigue-resistant. At the same time, engineers and designers are being pressed to produce these designs in ever-shortening time intervals. Consequently, they have to quickly produce analyses that are accurate or if inaccurate, they have to make sure they err on the safe side.

In response to these demands, engineers and designers are increasingly relying upon finite element methods (FEM) and analogous computational procedures for their designs. However, these methods are primarily methods of analysis and are thus most useful for evaluating proposed designs. Moreover, they are often expensive, inaccessible and sensitive to element selection and assumptions on loadings and support conditions. In short, they are not always free of error. Even with steady improvements in FEM accuracy, accessibility, and ease of use, engineers and designers still need to be able to readily make accurate stress and deformation analyses without undue computation. Recognising this need, Alexander Blake published his widely used practical stress analysis in 1982, just when FEM and related methods were becoming popular.

In this third edition of practical stress analysis in engineering design, we have completely rewritten and updated the text of the second edition while maintaining Blake's popular style. Our objective is to produce a book to help engineers and designers easily obtain stress and deformation results for the wide class of common mechanical components. In addition, we have attempted to supplement the methodologies with a presentation of theoretical bases. At the end of each chapter, a list of references is provided for a more detailed investigation and also a list of symbols is presented to aid the reader.

This book is divided into seven parts and consists of 40 chapters. In the first part, we review fundamental concepts including basic ideas such as stress, strain and Hooke's law. We include analysis in two and three dimensions as well as the use of curvilinear coordinates.

In the second part, we review the fundamental concepts of beam bending and twisting of rods. We introduce the use of singularity functions for analysis of complex loadings. These two parts provide the basis for the topics in the remainder of the book. Curvilinear coordinates and singularity functions are two new topics in this edition.

The third part considers special beam geometries focusing upon thick beams, shear stress in beams, curved beams, buckling of beams and shear centres. In the fourth part, we extend the analysis to plates, panels, flanges and brackets. We review the fundamentals of plate bending and then apply the theory to special plate configurations with a focus on circular and annular plates, flanges and brackets, panels and perforated/reinforced plates.

The fifth part is devoted to dynamic effects including the concepts of fracture and fatigue failure. We consider design for seismic loading and impacts and explore stress propagation. We conclude this part with design concepts to control and prevent fatigue and fracture for systems with repeated and periodic loadings.

The sixth part discussed piping and various pressure vessel problems and considers both internal and external pressurised vessels. Bending, buckling and other vessel responses to high pressure are evaluated. The part concludes with a consideration of some designs for stiffening of cylindrical vessels. The seventh part considers some advanced and specialised topics including stress concentrations, thermal effects, rings, arches, links and springs.

8 Friction Science and Technology, From Concepts to Applications – 2nd edition by: P.J. Blau

Published 2009 by CRC Taylor & Francis Group, Boca Raton, London, New York, 6000 Broken Sound Parkway NW, Suite 300, Boca Raton, Florida 33487-2742, USA. 420pp.
ISBN: 978-1-4200-5404-0

The first edition appeared in late 1995. Since that time, there have been many new developments in our understanding of friction. Examples of these are new ASTM standards for friction measurement, laser dimpled surfaces for friction control, friction of nanocomposites and alloys for light-weight bearings, and most importantly, leading edge research on friction at the molecular scale-perhaps the fastest growing aspect of the field.

This book begins with a thorough development of the history of thought on the subject of friction, which puts the book in context. This history provides grounding for the main goal of this book, which is to address the mechanics, materials, and applications-oriented aspects of friction and friction technology. As a result, this book does a fine job of comprehensively covering the subject. Key topic areas are mechanics-based treatments of friction, including typical problems and equations for estimating the effects of friction in simple machines; the wide range of devices that have been crafted to measure the magnitude of friction, some designed to simulate the behaviour of engineering tribosystems; modelling of static and kinetic friction; the effects of tribosystem variables such as load, speed, temperature, surface texture, and vibration on frictional behaviour, the result of which demonstrates how the same materials can exhibit much different frictional behaviour when the contact conditions are changed and the response of different types of material combinations to frictional contact.

The think the discussion on the same materials exhibiting different frictional behaviour under differing contact conditions is particularly beneficial as so often in the past engineers would look up a material's inherent coefficient of friction in some handbooks, apply that to a design, with the result of total mystification that the resultant friction is much different. Subsequent chapters deal with run-in processes, which I found interesting as the importance of this is particularly acute in the bearings used in laser targeting and high-resolution photo imaging devices. There is also a useful chapter on lubrication by gases, liquids and solids.

There is also an interesting chapter on the solid friction of materials. It covers a wide variety of combinations such as leather, wood, stone, metals, a variety of alloys, metallic glasses, ceramics, polymers, carbon-/diamond-like materials, ice structures, just to name a few. A unique feature is the inclusion in various chapters of numerous interesting and unusual examples of the application of friction science, proving that tribologists and tribological problems are truly indispensable and multidisciplinary. A few examples covered in the book that highlight the breath of these applications are friction problems in Olympic and other sports, coatings for icebreakers, interparticle friction (toners, pills, powders, etc.), cosmetics, starting a fire caveman style, joint replacement, reducing heat in dental root canal tools, the touch of piano keys, human skin friction, the drag of ships through the water, earthquakes and the 'bounce' in shampoo. This aspect of the book alone makes it an interesting read for both highly technical people as well as those with more than the usual curiosity for how things work.

9 Corrosion and Corrosion Control, An Introduction to Corrosion Science and Engineering – 4th edition by: R.W. Revie and H.H. Uhlig Published 2009 by CRC Taylor & Francis Group, Boca Raton, London, New York, 6000 Broken Sound Parkway NW, Suite 300, Boca Raton, Florida 33487-2742, USA. 490pp. ISBN: 978-1-4200-5404-0

The three main global challenges for the 21st century are energy, water, and air-that is, sufficient energy to ensure a reasonable standard of living, clean water to drink, and clean air to breathe. The ability to manage corrosion is a central part of using materials effectively and efficiently to meet these challenges. For example, oil and natural gas are transmitted across continents using high-pressure steel pipelines that must operate for decades without failure, so that neither the groundwater nor the air is unnecessarily polluted.

In design, operation, and maintenance of nuclear power plants, management of corrosion is critical. The reliability of materials used in nuclear waste disposal must be sufficient so that that the safety of future generations is not compromised.

Materials reliability is becoming ever more important in our society, particularly in view of the liability issues that develop when reliability is not assured, safety is compromised, and failure occurs. Notwithstanding the many years over which university, college, and continuing education courses in corrosion have been available, high-profile corrosion failures continue to take place. Although the teaching of corrosion should not be regarded as a dismal failure, it has certainly not been a stellar success providing all

engineers and technologists a basic minimum 'literacy level' in corrosion that would be sufficient to ensure reliability and prevent failures.

One objective of preparing the fourth edition of this book is to present to students an updated overview of the essential aspects of corrosion science and engineering that underpin the tools that are available and the technologies that are used for managing corrosion and preventing failures. A second objective is to engage students, so that they are active participants in understanding corrosion and solving problems, rather than passively observing the smorgasbord of information presented. The main emphasis is on quantitative presentation, explanation, and analysis wherever possible; for example, in this new edition, the galvanic series in seawater is presented with the potential range of each material, rather than only as a qualitative list. Considering the potential ranges that can be involved, the student can see how anodic/cathodic effects can develop, not only when different materials form a couple, but also when materials that is nominally the same are coupled.

This is primarily a textbook for students and others who need a basic understanding of corrosion. The book is also a reference and starting point for engineers, researchers, and technologists requiring specific information. The book includes discussion of the main materials that are available, including alloys both old and new. For consistency with current practice in metallurgical and engineering literature, alloys are identified with their UNS numbers as well as with their commonly used identifiers. To answer the question from students about why so many alloys have been developed and are commercially available, the contributions of individual elements to endow alloys with unique properties that are valuable for specific applications are discussed. Throughout the book, there are numerous references to further sources of information, including handbooks, other books, reviews, and papers in journals. At the end of each chapter, there is a list of 'General References' pertinent to that chapter, and most of these were published in 2000 and later.

10 Solid State Physics, Problems and Solutions – 2nd, revised and enlarged edition by: L. Mihálya and M.C. Martin Published 2009 by Wiley-VCH Verlag GmbH & Co.KGaA, Weinheim, Germany. 315pp. ISBN: 978-3-527-40855-9

They wrote this book to satisfy another need as well: to help measure the progress of the students at midterms, finals, and comprehensive exams. Every professor must have a set of carefully guarded problems, appropriate to the final exam of the course she/he is teaching (better yet to have several sets, if you are teaching in several consecutive semesters). One would like to share and discuss these – presumably interesting – physics questions with the students, but practical considerations do not allow for this; if a problem is given out as a homework assignment, its value as a final exam problem is greatly and understandably reduced. Our goal here was to provide a volume of problems greater in number than the 'critical mass' number, which can be memorised. If a student remembers all of the solutions for a sufficiently large set of problems, he or she pretty much knows the subject (for proof, see the argument in the first paragraph).

The problems and solutions presented in this book stem from several years of teaching advanced undergraduate and introductory graduate solid-state physics courses in

the Physics Department of SUNY @ Stony Brook. During these courses we used several of the excellent textbooks available; some of them are listed as references to the present collection of problems. Naturally, the problems ere developed and organised each year more or less in accord to the textbook used in that particular course. As we began to assemble the present collection, we planned to divide the problems into chapters corresponding to one of the standard organisations of the subject matter. However, we discovered that we do not need to be tied by the same constants as the typical introductory textbook: a particular aspect of superconductivity may be very well used to illustrate the concept of density of states; magnetism and charge density waves fit reasonably well under the umbrella of interacting electron systems.

We recommend the use of this collection in conjunction with one of the 'standard' textbooks. The textbook will provide the backbone of organisation that is very much needed for the first time encounter with the subject. The instructor should pick the appropriate problems and assign them (in tandem with the problems from the textbook) as the course proceeds. Presumably, by the end of the course, the problems not assigned can be used by the students for reviewing and integrating their knowledge. We also hope that the problems solved here will provide inspiration for creating other similar problems.

Several new problems were added covering aspects of grapheme, nanotubes, and other nanosystems. Surprisingly, many of the most modern developments in this area can be readily turned into graduate-level homework problems. We feel less apologetic now for using one- and two-dimensional systems for illustrating physical concepts: they are realised and actively studied by our experimental friends in the lab.

Solving homework problems is the single most effective way for students to familiarise themselves with the language and details of solid state physics. Testing problem-solving ability is the best means at the professor's disposal for measuring student progress at critical points in the learning process. This book enables any instructor to supplement end-of-chapter textbook assignments with a large number of challenging and engaging practice problems and discover a host of new ideas for creating exam questions. In addition to numerous updates, this revised edition includes a fortified optics chapter and an entirely new chapter on mesoscopic and nanoscale physics.

Solid State Physics: Problems and Solutions is designed to be used in tandem with any of the excellent textbooks on this subject. Each problem has been chosen for its ability to illustrate key concepts, properties, and systems, knowledge of which is crucial in developing a complete understanding of the subject, including:

- crystal structures
- interatomic forces and lattice vibrations
- electronic band structure
- density of states
- elementary excitations
- thermodynamics of noninteracting quasiparticles
- optical properties
- interactions and phase transitions
- mesoscopic and nanoscale systems.