

# Sir Charles Frank, OBE, FRS

An eightieth birthday tribute

Edited by

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# Sir Charles Frank Obe Frs An Eightieth Birthday Tribute

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## **Sir Charles Frank OBE FRS An Eightieth Birthday Tribute:**

**Sir Charles Frank OBE, FRS, An Eightieth Birthday Tribute** R. G. Chambers, 1991-02 Sir Charles Frank is one of the foremost scientists of the last fifty years He has made important advances in a large number of different fields in physics notably the properties of dislocations in crystals This book is a celebration of his work with contributions from many of his former colleagues and students The contributors are all eminent in their particular fields and the great variety in their contributions demonstrates the vast impact Sir Charles has had on modern physics The papers range over many of the fields in which Sir Charles has worked These include crystal growth and crystal properties liquid crystals particle physics metallurgy polymer physics materials science geophysics and the mechanics of the Earth's crust A major part of the book is concerned with the subject with which he is most closely associated namely the behaviour of dislocations in crystals The contributions are mainly of two types There are reviews of Sir Charles work concentrating on his original ideas and extensions of his theories that have been made by other researchers There are also original contributions describing the outcome of new and ongoing research showing that Sir Charles pioneering work is still producing important results Also included are reminiscences of Sir Charles life and work at Bristol and elsewhere with many anecdotes demonstrating his unique approach to research and teaching Because of the wide ranging nature of Sir Charles Frank's work this collection of essays will be of great interest to scientists in a wide range of fields

*Memorial Tributes* National Academy of Engineering, 2013-10-07 This is the 17th Volume in the series *Memorial Tributes* compiled by the National Academy of Engineering as a personal remembrance of the lives and outstanding achievements of its members and foreign associates These volumes are intended to stand as an enduring record of the many contributions of engineers and engineering to the benefit of humankind In most cases the authors of the tributes are contemporaries or colleagues who had personal knowledge of the interests and the engineering accomplishments of the deceased Through its members and foreign associates the Academy carries out the responsibilities for which it was established in 1964 Under the charter of the National Academy of Sciences the National Academy of Engineering was formed as a parallel organization of outstanding engineers Members are elected on the basis of significant contributions to engineering theory and practice and to the literature of engineering or on the basis of demonstrated unusual accomplishments in the pioneering of new and developing fields of technology The National Academies share a responsibility to advise the federal government on matters of science and technology The expertise and credibility that the National Academy of Engineering brings to that task stem directly from the abilities interests and achievements of our members and foreign associates our colleagues and friends whose special gifts we remember in this book

The Selected Works of John W. Cahn W. Craig Carter, William C. Johnson, 2013-10-28 This book represents a collection of 30 selected papers from the work of John W Cahn Dr Cahn is Senior Fellow at the Materials Science and Engineering Laboratory of the National Institute of Standards and Technology and is widely recognized as a



founder of modern theory and thought in materials science The range of his research included kinetics and mechanisms of metallurgical phase changes surfaces interfaces defects quasicrystals thermodynamics and other areas impacting the fundamental understanding of materials science Each paper includes a 2-4 page review of the impact and historical perspective of the work This is an important collection for students instructors and scientists interested in materials science

**Visual Differential Geometry and Forms** Tristan Needham, 2021-07-13 An inviting intuitive and visual exploration of differential geometry and forms Visual Differential Geometry and Forms fulfills two principal goals In the first four acts Tristan Needham puts the geometry back into differential geometry Using 235 hand drawn diagrams Needham deploys Newton's geometrical methods to provide geometrical explanations of the classical results In the fifth act he offers the first undergraduate introduction to differential forms that treats advanced topics in an intuitive and geometrical manner Unique features of the first four acts include four distinct geometrical proofs of the fundamentally important Global Gauss Bonnet theorem providing a stunning link between local geometry and global topology a simple geometrical proof of Gauss's famous Theorema Egregium a complete geometrical treatment of the Riemann curvature tensor of an  $n$  manifold and a detailed geometrical treatment of Einstein's field equation describing gravity as curved spacetime General Relativity together with its implications for gravitational waves black holes and cosmology The final act elucidates such topics as the unification of all the integral theorems of vector calculus the elegant reformulation of Maxwell's equations of electromagnetism in terms of 2 forms de Rham cohomology differential geometry via Cartan's method of moving frames and the calculation of the Riemann tensor using curvature 2 forms Six of the seven chapters of Act V can be read completely independently from the rest of the book Requiring only basic calculus and geometry Visual Differential Geometry and Forms provocatively rethinks the way this important area of mathematics should be considered and taught

**Natural Focusing and Fine Structure of Light** J.F Nye, 1999-01-01 A new kind of optics has grown up during the last 25 years Geometrical optics has been studied for centuries the law of reflection was known to the ancient Greeks and wave optics heralded by Huygens Treatise on Light has been studied for more than 300 years But in the mid 1970s it began to be understood that when natural processes focus light as when sunlight is reflected from the sea at sunset the light caustics that are produced have a systematic behavior previously unrecognized Natural Focusing and Fine Structure of Light Caustics and Wave Dislocations provides a definitive account of how classical optics has been reconstructed in a modern way by emphasizing the hierarchy of singularities that exists in light fields The book discusses the singularities of geometrical optics and their systematization by catastrophe theory It explores the diffraction patterns associated with caustics that are dominated by wave dislocations line singularities of the phase and analogous to crystal dislocations The book is a perfect blend of mathematics and physics combining theory computer simulation and beautiful experimental photographs of the phenomena studied

Geometric Phases in Classical and Quantum Mechanics Dariusz Chruscinski, Andrzej Jamiolkowski, 2012-12-06 Several well established geometric and



topological methods are used in this work in an application to a beautiful physical phenomenon known as the geometric phase. This book examines the geometric phase bringing together different physical phenomena under a unified mathematical scheme. The material is presented so that graduate students and researchers in applied mathematics and physics with an understanding of classical and quantum mechanics can handle the text.

**Ice Physics and the Natural Environment** John S. Wettlaufer, J. Gregory Dash, Norbert Untersteiner, 2013-06-29. The Advanced Study Institute Ice Physics in the Natural and Endangered Environment was held at Acquafredda di Maratea, Italy, from September 7 to 19, 1997. The ASI was designed to study the broad range of ice science and technology and it brought together an appropriately interdisciplinary group of lecturers and students to study the many facets of the subject. The talks and poster presentations explored how basic molecular physics of ice have important environmental consequences and conversely how natural phenomena present new questions for fundamental study. The series of lectures discusses these linkages in order that the overall unity of the subject and this volume can be perceived. Not all of the lecturers and participants were able to contribute a written piece, but their active involvement was crucial to the success of the Institute and thereby influenced the content of the volume. We began the Institute by retracing the history of the search for a microscopic understanding of melting. Our motivation was straightforward. Nearly every phenomenon involving ice in the environment is influenced by the change of phase from solid to liquid or vice versa. Hence a sufficiently deep physical picture of the melting transition enriches our appreciation of a vast array of geophysical and technical problems.

*Kinetics of Materials* Robert W. Balluffi, Samuel M. Allen, W. Craig Carter, 2005-12-07. KINETICS OF MATERIALS: A CLASSROOM TESTED TEXTBOOK PROVIDING A FUNDAMENTAL UNDERSTANDING OF BASIC KINETIC PROCESSES IN MATERIALS. This textbook, reflecting the hands-on teaching experience of its three authors, evolved from Massachusetts Institute of Technology's first-year graduate curriculum in the Department of Materials Science and Engineering. It discusses key topics collectively representing the basic kinetic processes that cause changes in the size, shape, composition, and atomistic structure of materials. Readers gain a deeper understanding of these kinetic processes and of the properties and applications of materials. Topics are introduced in a logical order, enabling students to develop a solid foundation before advancing to more sophisticated topics. *Kinetics of Materials* begins with diffusion, offering a description of the elementary manner in which atoms and molecules move around in solids and liquids. Next, the more complex motion of dislocations and interfaces is addressed. Finally, still more complex kinetic phenomena such as morphological evolution and phase transformations are treated. Throughout the textbook, readers are instilled with an appreciation of the subject's analytic foundations, and in many cases, the approximations commonly used in the field. The authors offer many extensive derivations of important results to help illuminate their origins. While the principal focus is on kinetic phenomena in crystalline materials, select phenomena in noncrystalline materials are also discussed. In many cases, the principles involved apply to all materials. Exercises with accompanying solutions are provided throughout.



Kinetics of Materials enabling readers to put their newfound knowledge into practice In addition bibliographies are offered with each chapter helping readers to investigate specialized topics in greater detail Several appendices presenting important background material are also included With its unique range of topics progressive structure and extensive exercises this classroom tested textbook provides an enriching learning experience for first year graduate students **Polymer**

**Crystallization** Günter Reiter,Jens-Uwe Sommer,2008-01-11 The classical view on polymer crystallization basically focused on the explanation of a few macroscopically observable parameters like the thickness of the resulting lamellar structure and the corresponding growth rates However the emerging paradigm for the description of chain crystals is too simple and cannot account for the complex non equilibrium processes responsible for structure formation on various levels ranging from the nanometer up to the millimeter scale This complexity detected by several novel experimental results led to a renewed interest in this old topic of polymer crystallization These new findings concern the early stages of the crystallization process crystal formation in confined geometries like ultra thin films and the competition between micro phase separation and crystallization in copolymers and blends In particular high spatial resolution techniques such as atomic force microscopy provided deeper insight into the molecular organization of crystallizable polymers Computer simulations based on microscopic processes were used to improve our understanding of how polymer crystals are nucleated and how they grow New ideas emerged about possible multistage pathways which are followed during the formation of polymer lamellae The importance and the consequences of the non equilibrium character of polymer crystals got significantly more attention Links and analogies to growth phenomena and pattern formation in general are being developed However these ideas are still subject of intensive and controversial discussions *Nonlinear Partial Differential Equations* Gui-Qiang Chen,Emmanuele DiBenedetto,1999

This volume is a collection of original research papers and expository articles stemming from the scientific program of the Nonlinear PDE Emphasis Year held at Northwestern University Evanston IL in March 1998 The book offers a cross section of the most significant recent advances and current trends and directions in nonlinear partial differential equations and related topics The book's contributions offer two perspectives There are papers on general analytical treatment of the theory and papers on computational methods and applications originating from significant realistic mathematical models of natural phenomena Also included are articles that bridge the gap between these two perspectives seeking synergistic links between theory and modeling and computation The volume offers direct insight into recent trends in PDEs This volume is also available on the Web Those who purchase the print edition can gain free access by going to [www.ams.org/conm](http://www.ams.org/conm)

Mathematical Research in Materials Science National Research Council,Division on Engineering and Physical Sciences,Commission on Physical Sciences, Mathematics, and Applications,Committee on Mathematical Sciences Applied to Materials Science,1993-02-01 This book describes fruitful past collaborations between the mathematical and materials sciences and indicates future challenges It seeks both to encourage mathematical sciences research that will complement



vital research in materials science and to raise awareness of the value of quantitative methods The volume encourages both communities to increase cross disciplinary collaborations emphasizing that each has much to gain from such an increase and it presents recommendations for facilitating such work This book is written for both mathematical and materials science researchers interested in advancing research at this interface for federal and state agency representatives interested in encouraging such collaborations and for anyone wanting information on how such cross disciplinary collaborative efforts can be accomplished successfully **Notes and Records of the Royal Society of London** Royal Society (Great Britain),1992

*The Coming of Materials Science* R.W. Cahn,2001-03-16 The Coming of Materials Science both covers the discipline of materials science and draws an impressionistic map of the present state of the subject The first chapter examines the emergence of the materials science concept in both academe and industry The second and third chapters delve back into the prehistory of materials science examining the growth of such concepts as atoms crystals and thermodynamics and also examine the evolution of a number of neighbouring disciplines to see what helpful parallels might emerge The book contains numerous literature references Many refer to the earliest key papers and books while others are to sources often books offering a view of the present state of a topic Early references are to the past but as the book continues it brings the reader up to date with more recent sources The author Professor Robert Cahn FRS has striven to be critical about the history of the discipline of materials science and to draw general conclusions about scientific practice from what he has discovered about the evolution of materials science Further issues that the book highlights include What is a scientific discipline How do disciplines merge and differentiate Can a discipline also be interdisciplinary Is materials science a real discipline A large range of themes is presented in the book and readers are invited to interact with the author if they reach alternative conclusions This book is not just for reading and reference but exists to stimulate thought and provoke discussion as well

**Structural Integrity and Durability of Advanced Composites** Peter Beaumont,C. Soutis,Alma Hodzic,2015-05-19 Structural Integrity and Durability of Advanced Composites Innovative Modelling Methods and Intelligent Design presents scientific and technological research from leading composite materials scientists and engineers that showcase the fundamental issues and practical problems that affect the development and exploitation of large composite structures As predicting precisely where cracks may develop in materials under stress is an age old mystery in the design and building of large scale engineering structures the burden of testing to provide fracture safe design is imperative Readers will learn to transfer key ideas from research and development to both the design engineer and end user of composite materials This comprehensive text provides the information users need to understand deformation and fracture phenomena resulting from impact fatigue creep and stress corrosion cracking and how these phenomena can affect reliability life expectancy and the durability of structures Presents scientific and technological research from leading composite materials scientists and engineers that showcase fundamental issues and practical problems Provides the information users need to understand



deformation and fracture phenomena resulting from impact fatigue creep and stress corrosion cracking Enables readers to transfer key ideas from research and development to both the design engineer and end user of composite materials

**Synthetic Diamond** Karl E. Spear, John P. Dismukes, 1994-04-04 A riveting look at the science technology and people involved in overcoming early impracticalities of the fledgling chemical vapor deposition CVD synthesis method and its development in today's state of commercial readiness Provides insights into numerous vapor phase techniques Surveys the synthesis structure properties and applications of diamondlike carbon Details current and rapidly emerging applications manufacturing and markets

*Crystal Growth Processes Based on Capillarity* Thierry Duffar, 2010-03-30 Crystal Growth Processes Based on Capillarity closely examines crystal growth technologies like Czochralski Floating zone and Bridgman The up to date reference contains detailed technical and applied information especially on the difficulty of crystal shape control Including practical examples and software applications this book provides both theoretical and experimental sections Edited by a well respected academic with over twenty five years of experience in this field the text is an excellent resource for professionals in crystal growth as well as for students in understanding the fundamentals and the technology of crystal growth

**Oxford Dictionary of National Biography: Flattisbury-Freston** Henry Colin Gray Matthew, Brian Harrison, 2004 55 000 biographies of people who shaped the history of the British Isles and beyond from the earliest times to the year 2002

**Twentieth Century Physics** Laurie M. Brown, Abraham Pais, 1995

**Morphology of Crystals** Ichiro Sunagawa, 1995-07-31 The molecular mechanisms underlying the fact that a crystal can take a variety of external forms is something we have come to understand only in the last few decades This is due to recent developments in theoretical and experimental investigations of crystal growth mechanisms Morphology of Crystals is divided into three separately available volumes Part A contains chapters on roughening transition equilibrium form step pattern theory modern PBC and surface microtopography This part provides essentially theoretical treatments of the problem particularly the solid liquid interface Part B contains chapters on ultra fine particles minerals transition from polyhedral to dendrite theory of dendrite and snow crystals All chapters are written by world leaders in their respective areas and some can be seen as representing the essence of a life's work This is the first English language work which covers all aspects of the morphology of crystals a topic which has attracted top scientific minds for centuries As such it is indispensable for anyone seeking an answer to a question relating to this fascinating problem mineralogists petrologists crystallographers materials scientists workers in solid state physics and chemistry etc In Parts A Fundamentals and B Fine Particles Minerals and Snow equilibrium and kinetic properties of crystals are generally approached from an atomistic point of view In contrast Part C The Geometry of Crystal Growth follows the alternative and complementary geometrical description where bulk phases are considered as continuous media and their interfaces as mathematical surfaces with orientation dependent properties Equations of motion for a crystal surface are expressed in terms of vector and tensor operators working on surface free energy and growth rate both



expressed as functions of surface orientation and driving force or affinity for growth This approach emphasizes the interrelation between equilibrium and kinetic behavior Part 1 establishes the theoretical framework Part 2 gives a construction toolbox for explicit analytic functions An extra chapter is devoted to experimental techniques for measuring such functions a new approach to sphere growth experiments The emphasis throughout is on principles and new concepts Audience Advanced readers familiar with traditional aspects of crystal growth theory Can be used as the basis for an advanced course provided supplementation is provided in the areas of atomistic models of the advancing surface diffusion fields etc

**Polymer Physics** U.W. Gedde, 2013-12-11 This book is the result of my teaching efforts during the last ten years at the Royal Institute of Technology The purpose is to present the subject of polymer physics for undergraduate and graduate students to focus the fundamental aspects of the subject and to show the link between experiments and theory The intention is not to present a compilation of the currently available literature on the subject Very few reference citations have thus been made Each chapter has essentially the same structure starting with an introduction continuing with the actual subject summarizing the chapter in 300-500 words and finally presenting problems and a list of relevant references for the reader The solutions to the problems presented in Chapters 1-12 are given in Chapter 13 The theme of the book is essentially polymer science with the exclusion of that part dealing directly with chemical reactions The fundamentals in polymer science including some basic polymer chemistry are presented as an introduction in the first chapter The next eight chapters deal with different phenomena processes and states of polymers The last three chapters were written with the intention of making the reader think practically about polymer physics How can a certain type of problem be solved What kinds of experiment should be conducted This book would never have been written without the help of my friend and adviser Dr Anthony Bristow who has spent many hours reading through the manuscript criticizing the content



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