

# Micromechanics Of Defects In Solids

Theory of Defects in Solids Point Defects in Solids Defects in Solids Point Defects in Solids Point Defects in Solids Point Defects in Solids Theories of Defects in Solids Defects in Crystalline Solids Point Defects in Solids Defects in Solids Defects in Solids Point Defects in Solids Micromechanics of Defects in Solids Defects in Solids Micromechanics of Defects in Solids Defects and Diffusion in Solids DEFECTS IN SOLIDS. Defects and Disorder in Crystalline and Amorphous Solids Treatise on Solid State Chemistry Imperfections in Crystalline Solids A. M. Stoneham James H. Crawford Richard J. D. Tilley James H. Crawford James H. Crawford James H. Crawford Marshall Stoneham B. Henderson James H. Crawford N. Hannay A.V. Chadwick Lawrence M. Slifkin T. Mura Norman Bruce Hannay Toshio Mura Stanisław Mrowec Norman Bruce Hannay Richard Catlow Norman Bruce Hannay Wei Cai

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this book surveys the theory of defects in solids concentrating on the electronic structure of point defects in insulators and semiconductors the relations between different approaches are described and the predictions of the theory compared critically with experiment the physical assumptions and approximations are emphasized the book begins with the perfect solid then reviews the main methods of calculating defect energy levels and wave functions the calculation and observable defect properties is discussed and finally the theory is applied to a range of defects that are very different in nature this book is intended for research workers and graduate students interested in solid state physics from reviews of the hardback it is unique and of great value to all interested in the basic aspects of defects in solids physics today this is a particularly worthy book one which has long been needed by the theoretician and experimentalist alike nature

crystal defects can no longer be thought of as a scientific curiosity but must be considered an important aspect of solid state science this is largely because many of the more interesting properties of crystalline solids are disproportionately dominated by effects due to a tiny concentration of imperfections in an otherwise perfect lattice the physics of such lattice defects is not only of significance in a great variety of applications but is also interesting in its own right thus an extensive

science of point defects and dislocations has been constructed during the past two and a half decades stimulated by the technological and scientific interest in plasticity there have appeared in recent years rather a large number of books dealing with dislocations in the case of point defects however only very few broad and extensive treatments have been published thus there are few comprehensive tutorial sources for the scientist or engineer whose research activities are affected by point defect phenomena or who might wish to enter the field it is partially to fill this need that the present treatise aims

provides a thorough understanding of the chemistry and physics of defects enabling the reader to manipulate them in the engineering of materials reinforces theoretical concepts by placing emphasis on real world processes and applications includes two kinds of end of chapter problems multiple choice to test knowledge of terms and principles and more extensive exercises and calculations to build skills and understanding supplementary material on crystallography and band structure are included in separate appendices

volume 1 of point defects in solids has as its major emphasis defects in ionic solids volume 2 now extends this emphasis to semiconductors the first four chapters treat in some detail the creation kinetic behavior interactions and physical properties of both simple and composite defects in a variety of semiconducting systems also included as in vol 1 are chapters on special topics namely phonon defect interactions and defects in organic crystals defect behavior in semiconductors has been a subject of considerable interest since the discovery some twenty five years ago that fast neutron irradiation profoundly affected the electrical characteristics of germanium and silicon present day interest has been stimulated by such semiconductor applications as solar cell power plants for space stations and satellites and semiconductor particle and  $\gamma$  ray detectors since in both radiation damage can cause serious deterioration of even greater practical concern is the need to understand particle damage in order to capitalize upon the developing technique of ion implantation as a means of device fabrication although the periodic international conferences on radiation effects in semiconductors have served the valuable function of summarizing the extensive work being done in this field these proceedings are much too detailed and lack the background discussion needed to make them useful to the novice

this book surveys the theory of defects in solids concentrating on the electronic structure of point defects in insulators and semiconductors the relations between different approaches are described and the predictions of the theory compared critically with experiment the physical assumptions and approximations are emphasized theory of defects in solids begins with the perfect solid then reviews the main methods of calculating defect energy levels and wave functions the calculation of observable defect properties is discussed and finally the theory is applied to a range of defects that are very different in nature this book is intended for research workers and graduate students interested in solid state physics

the last quarter century has been marked by the extremely rapid growth of the solid state sciences they include what is now the largest subfield of physics and the materials engineering sciences have likewise flourished and playing an active role throughout this vast area of science and engineering have been very large numbers of chemists yet even though the role of chemistry in the solid state sciences has been a vital one and the solid state sciences have in turn made enormous

contributions to chemical thought solid state chemistry has not been recognized by the general body of chemists as a major subfield of chemistry solid state chemistry is not even well defined as to content some for example would have it include only the quantum chemistry of solids and would reject thermodynamics and phase equilibria this is nonsense solid state chemistry has many facets and one of the purposes of this treatise is to help define the field perhaps the most general characteristic of solid state chemistry and one which helps differentiate it from solid state physics is its focus on the chemical composition and atomic configuration of real solids and on the relationship of composition and structure to the chemical and physical properties of the solid real solids are usually extremely complex and exhibit almost infinite variety in their compositional and structural features

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this book stems from a course on micromechanics that i started about fifteen years ago at northwestern university at that time micromechanics was a rather unfamiliar subject although i repeated the course every year i was never convinced that my notes have quite developed into a final manuscript because new topics emerged constantly requiring revisions and additions i finally came to realize that if this is continued then i will never complete the book to my total satisfaction meanwhile t mori and i had coauthored a book in japanese entitled micromechanics published by baifu kan tokyo in 1975 it received an extremely favorable response from students and researchers in japan this encouraged me to go ahead and publish my course notes in their latest version as this book which contains further development of the subject and is more comprehensive than the one published in japanese micromechanics encompasses mechanics related to microstructures of materials the method employed is a continuum theory of elasticity yet its applications cover a broad area relating to the mechanical behavior of materials plasticity fracture and fatigue constitutive equations composite materials polycrystals etc these subjects are treated in this book by means of a powerful and unified method which is called the eigenstrain method in particular problems relating to inclusions and dislocations are most effectively analyzed by this method and therefore special emphasis is placed on these topics

the study of defects and disorder in solids remains a central topic in solid state science developments in the field continue to be promoted by new experimental

and theoretical techniques while further impetus for the study of disorder in solids is provided by the growing range of applications of solid state materials in which disorder at the atomic level plays a crucial role in this book we attempt to present a survey of fundamental and applied aspects of the field we consider the basic aspects of defective crystalline and amorphous solids we discuss recent studies of structural electronic transport thermodynamic and spectroscopic properties of such materials experimental and theoretical methodologies are reviewed and detailed consideration is given to materials such as fast ion conductors and amorphous semiconductors that are of importance in an applied context any survey of this large field is necessarily selective we have chosen to emphasise insulating especially oxidic and semi conducting materials but many of the approaches and techniques we describe apply generally across the entire field of solid state science this volume is based on a nato asi held at the residencia santa teresa de jesus madrid in september 1991 the editor is grateful to the nato scientific affairs division for their sponsorship of this school thanks are also due to all who participated in and lectured at the school but especially to the organising committee of a v chadwick g n greaves m grigorkiewicz j h harding and s kalbitzer c r a

this textbook provides students with a complete working knowledge of the properties of imperfections in crystalline solids readers will learn how to apply the fundamental principles of mechanics and thermodynamics to defect properties in materials science gaining all the knowledge and tools needed to put this into practice in their own research beginning with an introduction to defects and a brief review of basic elasticity theory and statistical thermodynamics the authors go on to guide the reader in a step by step way through point line and planar defects with an emphasis on their structural thermodynamic and kinetic properties numerous end of chapter exercises enable students to put their knowledge into practice and with solutions for instructors and matlab programs available online this is an essential text for advanced undergraduate and introductory graduate courses in crystal defects as well as being ideal for self study

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