

**OPTOELECTRONIC  
PROPERTIES of  
SEMICONDUCTORS  
and SUPERLATTICES**

M.O. Manasreh, *series editor*

Volume 18

**LEAD CHALCOGENIDES  
PHYSICS AND APPLICATIONS**

*Edited by*

**Dmitriy Khokhlov**



**CRC Press**  
Taylor & Francis Group

# Semiconductors Chalcogenides

**Gurinder Kaur Ahluwalia**



## **Semiconductors Chalcogenides:**

*Applications of Chalcogenides: S, Se, and Te* Gurinder Kaur Ahluwalia, 2016-11-02 This book introduces readers to a wide range of applications for elements in Group 16 of the periodic table such as optical fibers for communication and sensing X ray imaging electrochemical sensors data storage devices biomedical applications photovoltaics and IR detectors the rationale for these uses the future scope of their applications and expected improvements to existing technologies Following an introductory section the book is broadly divided into three parts dealing with Sulfur Selenium and Tellurium The sections cover the basic structure of the elements and their compounds in bulk and nanostructured forms properties that make these useful for various applications followed by applications and commercial products As the global technology revolution necessitates the search for new materials and more efficient devices in the electronics and semiconductor industry

*Applications of Chalcogenides S Se and Te* is an ideal book for a wide range of readers in industry government and academic research facilities looking beyond silicon for materials used in the electronic and optoelectronic industry as well as biomedical applications

**Amorphous Chalcogenide Semiconductors and Related Materials** Keiji Tanaka, Koichi Shimakawa, 2021-07-01 This book provides introductory comprehensive and concise descriptions of amorphous chalcogenide semiconductors and related materials It includes comparative portraits of the chalcogenide and related materials including amorphous hydrogenated Si oxide and halide glasses and organic polymers It also describes effects of non equilibrium disorder in comparison with those in crystalline semiconductors

*Chalcogenides* Alexander V. Kolobov, Junji Tominaga, 2012-08-22 A state of the art description of metastability observed in chalcogenide alloys is presented with the accent on the underlying physics A comparison is made between sulphur selenium based chalcogenide glasses where numerous photo induced phenomena take place entirely within the amorphous phase and tellurides where a reversible crystal to amorphous phase change transformation is a major effect Applications of metastability in devices optical memories and nonvolatile electronic phase change random access memories among others are discussed including the latest trends Background material essential for understanding current research in the field is also provided

*Electrochemistry of Metal Chalcogenides* Mirtat Bouroushian, 2010-04-23 The author provides a unified account of the electrochemical material science of metal chalcogenide MCh compounds and alloys with regard to their synthesis processing and applications Starting with the chemical fundamentals of the chalcogens and their major compounds the initial part of the book includes a systematic description of the MCh solids on the basis of the Periodic Table in terms of their structures and key properties This is followed by a general discussion on the electrochemistry of chalcogen species and the principles underlying the electrochemical formation of inorganic compounds alloys The core of the book offers an insight into available experimental results and inferences regarding the electrochemical preparation and microstructural control of conventional and novel MCh structures It also aims to survey their photoelectrochemistry both from a material oriented point of view and as connected to

specific processes such as photocatalysis and solar energy conversion Finally the book illustrates the relevance of MCh materials to various applications of electrochemical interest such as electro catalysis in fuel cells energy storage with intercalation electrodes and ion sensing

**Introduction to Semiconductors** Peter Sutter, 2025-08-05 This textbook provides a new perspective on the classic topic of Semiconductor Materials and Devices It aims at undergraduate and beginning graduate students in the physical sciences and in engineering This book combines two unique aspects i Making quantum mechanical concepts broadly accessible Rather than avoiding fundamental concepts such as electronic band structure and phonons as is the case in the established texts on semiconductors the book embraces and incorporates them as key building blocks While conceptually sound and rigorous this textbook avoids unnecessary detail to provide students with a solid understanding of key concepts while enabling rapid progress toward the learning goals ii Extensive examples sourced from contemporary research Advanced topics from the current literature past 10 years are included as natural extensions to each chapter of the book These contemporary examples broaden the students knowledge beyond the typical content of an introductory textbook provide relevant literature references and encourage further reading and self study In this way the extensions help educate the students for careers in the post silicon era Provides a concise introduction to semiconductor materials and devices accessible to students of varying backgrounds Makes extensive use of current real examples to facilitate understanding and motivate further reading Prepares students for careers in semiconductor research and development device design and manufacturing

**Amorphous Chalcogenides** Victor I. Mikla, Victor V. Mikla, 2011-09-23 Amorphous chalcogenide semiconductors have commercial value and have many uses such as image formation including x rays and high definition TV pick up tubes They have widespread application in the microelectronics industry and amorphous metallic alloys also have useful magnetic properties This book focuses on their imaging applications and related properties It examines the two groups of amorphous semiconductors that are of most commercial interest 1 the chalcogenide glasses 2 the tetrahedrally bonded amorphous solids such as amorphous silicon germanium and related alloys Both of these groups may be conveniently prepared in the form of thin thick films which is of considerable importance in applications where large area coverage of flat or curved surfaces of rigid or flexible materials is desirable such as in photovoltaic arrays X Ray sensors display screens and photocopier drums Provides information on the amorphous semiconductors that are of most commercial interest Presents the history of the commercial applications the latest developments and future possibilities

**Semiconducting Chalcogenide Glass II** Robert Fairman, Boris Ushkov, 2004-12-17 Chalcogenide glass is made up of many elements from the Chalcogenide group The glass is transparent to infrared light and is useful as a semiconductor in many electronic devices For example chalcogenide glass fibers are a component of devices used to perform laser surgery The properties of chalcogenide glass result not only from their chemical composition and atomic structure but also from the impact of numerous external factors A comprehensive survey is presented of the properties of chalcogenide glass under

various external impacts Practical recommendations are presented for a wide range of applications Part II is the second part of a three volume work within the Semiconductors and Semimetals series The first collective monograph written by Eastern European scientists on the electrical and optical properties of chalcogenide vitreous semiconductors CVS Contributions by B G Kolomiets who discovered the properties of chalcogenide glass in 1955 Provides objective evidence and discussion by authors from opposing positions **Metastable States in Amorphous Chalcogenide Semiconductors** Victor I.

Mikla,Victor V. Mikla,2009-12-24 This book presents experimental results on the structural and electronic metastable states in Se rich chalcogenides Coverage includes states in the mobility gap structural transformation photocrystallization and many potential related applications **Amorphous Chalcogenide Semiconductors and Related Materials** Keiji

Tanaka,Koichi Shimakawa,2011-05-24 Amorphous Chalcogenide Semiconductors and Glasses describes developments in the science and technology of this class of materials This book offers an up to date treatment of chalcogenide glasses and amorphous semiconductors from basic principles to applications while providing the reader with the necessary theoretical background to understanding the material properties technology of this class of materials This book offers an up to date treatment of chalcogenide glasses and amorphous semiconductors from basic principles to applications while providing the reader with the necessary theoretical background to understanding the material properties Chalcogenides form a special class of materials which have one or more of the elements from the chalcogen group Group VI in the Periodic Table S Se or Te as a constituent the chalcogen is mixed with other elements to form various new compounds and alloys Chalcogenides are noncrystalline solids because their structure is amorphous or glassy Such structures have totally different properties than crystalline solids Chalcogenide glasses have a number of very interesting and useful properties which have been already exploited in the commercialization of new devices **Chalcogenide** Xinyu Liu,Sanghoon Lee,Jacek K. Furdyna,Tengfei

Luo,Yong Zhang,2019-11-14 Chalcogenide From 3D to 2D and Beyond reviews graphene like 2D chalcogenide systems that include topological insulators interesting thermoelectric structures and structures that exhibit a host of spin phenomena that are unique to 2D and lower dimensional geometries The book describes state of the art materials in growth and fabrication magnetic electronic and optical characterization as well as the experimental and theoretical aspects of this family of materials Bulk chalcogenides chalcogenide films their heterostructures and low dimensional chalcogenide based quantum structures are discussed Particular attention is paid to findings that are relevant to the continued search for new physical phenomena and new functionalities Finally the book covers the enormous opportunities that have emerged as it has become possible to achieve lower dimensional chalcogenide structures by epitaxial techniques Provides readers with foundational information on the materials growth fabrication magnetic electronic and optical characterization of chalcogenide materials Discusses not only bulk chalcogenides and chalcogenide thin films but also two dimensional chalcogenide materials systems Reviews the most important applications in optoelectronics photovoltaics and thermoelectrics **Springer Handbook of**

**Semiconductor Devices** Massimo Rudan, Rossella Brunetti, Susanna Reggiani, 2022-11-10 This Springer Handbook comprehensively covers the topic of semiconductor devices embracing all aspects from theoretical background to fabrication modeling and applications Nearly 100 leading scientists from industry and academia were selected to write the handbook's chapters which were conceived for professionals and practitioners material scientists physicists and electrical engineers working at universities industrial R D and manufacturers Starting from the description of the relevant technological aspects and fabrication steps the handbook proceeds with a section fully devoted to the main conventional semiconductor devices like e g bipolar transistors and MOS capacitors and transistors used in the production of the standard integrated circuits and the corresponding physical models In the subsequent chapters the scaling issues of the semiconductor device technology are addressed followed by the description of novel concept based semiconductor devices The last section illustrates the numerical simulation methods ranging from the fabrication processes to the device performances Each chapter is self contained and refers to related topics treated in other chapters when necessary so that the reader interested in a specific subject can easily identify a personal reading path through the vast contents of the handbook

**Semiconductors** T. F. Connolly, 2012-12-06 And often on request from the issuing installation USAEC reports are also available from International Atomic Energy Agency Kaerntnerring A 1010 Vienna Austria National Lending Library Boston Spa England Monographs and reports of the National Bureau of Standards are for sale by Superintendent of Documents U S Government Printing Office Washington D C 20402 Theses listed as Dissertation Abstracts number are available in North and South America from University Microfilms Dissertation Copies P O Box 1764 Ann Arbor Michigan 48106 and elsewhere from University Microfilms Ltd St John's Road Tylers Green Penn Buckinghamshire England Conlenls Addendum xiii 1 Information Centers and Other Services 1 2 Journals 3 3 Methods of Crystal Growth Books and Reviews 5 4 Semiconductors General Reviews and Bibliographies 11 5 1 V VI Compounds 21 6 li IV V2 Compounds 23 7 II V Compounds 29 a General Reviews and Bibliographies 29 b Zinc Compounds 30 1 Zn3P2 30 2 ZnAs 30 3 ZnSb 30 4 Zn Mixed Systems 31 c Cadmium Compounds 31 31 1 Cd3P2 2 Cd3As2 31 3 CdSb Cd3Sb2 33 37 8 li VI Compounds a General Reviews and Bibliographies 37 b Zinc Compounds 39 1 ZnO 39 Preparation and Properties 39 Electrical Properties 41 Optical Properties 45 Physical Properties and Structure 47 2 ZnS 49 3 ZnSe 52 4 ZnTe 54 5 Zn Mixed Systems 55 55 c Cadmium Compounds 55 1 CdS 2 CdSe 60 3 CdTe 61 4 CdTernaries 62 d Mercury Compounds 64

**Band Structure of Semiconductors** I. M. Tsidilkovski, 2016-10-19 Band Structure of Semiconductors provides a review of the theoretical and experimental methods of investigating band structure and an analysis of the results of the developments in this field The book presents the problems methods and applications in the study of band structure Topics on the computational methods of band structure band structures of important semiconducting materials behavior of an electron in a perturbed periodic field effective masses and g factors for the most commonly encountered band structures and the treatment of cyclotron resonance Shubnikov de Haas oscillations

magnetophonon resonance and magneto optical phenomena are discussed Experimental physicists theoretical physicists students and research workers and engineers working in the field of semiconductor electronics will find this book a great source of vital information      Metal Chalcogenide Nanostructures for Renewable Energy Applications Ahsanulhaq Qurashi,2014-11-21 This first ever reference book that focuses on metal chalcogenide semiconductor nanostructures for renewable energy applications encapsulates the state of the art in multidisciplinary research on the metal chalcogenide semiconductor nanostructures nanocrystals nanoparticles nanorods nanowires nanobelts nanoflowers nanoribbons and more The properties and synthesis of a class of nanomaterials is essential to renewable energy manufacturing and this book focuses on the synthesis of metal chalcogenide nanostructures their growth mechanism optical electrical and other important properties and their applications in different diverging fields like photovoltaics hydrogen production thermoelectrics lithium battery energy storage photocatalysis sensors An important reference source for students scientists engineers researchers and industrialists working on nanomaterials based energy aspects associated with chemistry physics materials science electrical engineering energy science and technology and environmental science      **Metal-Chalcogenide**

**Nanocomposites** Mohammad Ehtisham Khan,Jeenat Aslam,2023-11-19 Metal chalcogenides have exceptional properties and can be used for electronic devices environmental monitoring and sensing applications for energy storage as electrode materials in fuel cells membranes and for photocatalytic degradation of environmental pollutants in the field of waste water treatment applications Metal Chalcogenide Nanocomposites Fundamentals Properties and Industrial Applications focuses on metal chalcogenide nanomaterials for environmental remediation and corrosion applications The chapters focuses on cost effective and facile fabrication approaches their growth mechanisms optical electrical and other important properties and their applications in a broad range of diverse fields such as photocatalysis photovoltaics hydrogen production lithium batteries energy storage anticorrosion and sensor devices The book will be an important information source for both material scientists and engineers who want to create the next generation of products and devices for energy and environmental applications Covers fabrication standard characterization photocatalytic mechanisms and environmentally sustainable fabrication methods Applications covered include environmental electronics oil gas water treatment sensing and many more Includes challenges and future opportunities which are discussed in detail      *State-of-the-Art Program on Compound Semiconductors : (SOTAPOCS XLII) and Processes at the Compound-Semiconductor/Solution Interface* P. C. Chang,2005

**Recent advances in heavily doped plasmonic copper chalcogenides: from synthesis to biological application** Qiulian Mao,Jicun Ma,Mei Chen,Shiying Lin,Noman Razzaq, Jiabin Cui,2023-05-26 Copper based chalcogenide compounds have emerged as alternative materials to Cd or Pb based traditional semiconductors and have drawn significant attention Compared with widely reported semiconductors copper chalcogenide nanocrystals NCs with abundant copper defects and vacancies present p type features Additionally the migration of free hole carriers in copper based chalcogenide NCs

produced a metal like local surface plasmon resonance LSPR effect In this review we focused on the plasmonic copper chalcogenide NCs achieved through a heavily doped strategy The copper sulfur compounds with versatile atomic ratios and complex crystal structures exhibit rich electrical optical and magnetic properties making them highly promising for a broad range of applications from energy conversion to biomedical fields Therefore our main focus is on the classification of copper chalcogenide synthesis strategies theoretical studies of doping doping strategies and biological applications We aim to analyze the trends of copper based chalcogenide nanomaterials for clinical applications by summarizing previous studies and presenting designs and concepts in a brief manner

*Chalcogenide-Based Nanomaterials as Photocatalysts* Mohammad Mansoob Khan, 2021-04-07 Chalcogenide Based Nanomaterials as Photocatalysts deals with the different types of chalcogenide based photocatalytic reactions covering the fundamental concepts of photocatalytic reactions involving chalcogenides for a range of energy and environmental applications Sections focus on nanostructure control synthesis methods activity enhancement strategies environmental applications and perspectives of chalcogenide based nanomaterials The book offers guidelines for designing new chalcogenide based nanoscale photocatalysts at low cost and high efficiency for efficient utilization of solar energy in the areas of energy production and environment remediation Provides information on the development of novel chalcogenide based nanomaterials Outlines the fundamentals of chalcogenides based photocatalysis Includes techniques for heterogeneous catalysis based on chalcogenide based nanomaterials

*Chalcogenide* Abhay Kumar Singh, Tien-Chien Jen, 2021-04-26 This is introductory book for researchers scientists and students in the area of organic and inorganic composite materials This book has addressed timely the innovative topic chalcogenide multiwalled carbon nanotubes and chalcogenide bilayer graphene composite materials under a glassy regime This book will give a clear idea on the concepts of the newly established composite materials area by providing interpretations of inside physio chemical mechanism The remarkable landmark innovations related to this newly introduced research field are included in this book Additionally the possible futuristic applications in the area of nanoelectronics optoelectronics biomedical etc are also addressed

**Semiconducting Chalcogenide Glass I** Robert Fairman, Boris Ushkov, 2004-05-10 Chalcogenide glass is made up of many elements from the Chalcogenide group The glass is transparent to infrared light and is useful as a semiconductor in many electronic devices For example chalcogenide glass fibers are a component of devices used to perform laser surgery This book is a comprehensive survey of the current state of science and technology in the field of chalcogenide semiconductor glasses While the majority of the book deals with properties of chalcogenide glass chapters also deal with industrial applications synthesis and purification of chalcogenide glass and glass structural modification The first individual or collective monograph written by Eastern European scientists known to Western readers regarding structural and chemical changes in chalcogenide vitreous semiconductors CVS Chapters written by B G Kolomiets who discovered the properties of chalcogenide glass in 1955 Provides evidence and discussion for problems discussed by authors from opposing positions



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