

# Nanosilicon

Properties, Synthesis,  
Applications, Methods of  
Analysis and Control



**A. A. Ischenko, G. V. Fetisov  
and  
L. A. Aslanov**



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# Nanosilicon Properties Synthesis Applications Methods Of Analysis And Control

**Munir H. Nayfeh**

## **Nanosilicon Properties Synthesis Applications Methods Of Analysis And Control:**

**Nanosilicon** Anatoly A. Ischenko, Gennady V. Fetisov, Leonid A. Aslalnov, 2014-07-23 Nanosilicon Properties Synthesis Applications Methods of Analysis and Control examines the latest developments on the physics and chemistry of nanosilicon. The book focuses on methods for producing nanosilicon and its electronic and optical properties research methods to characterize its spectral and structural properties and its possible applications. The first part of the book covers the basic properties of semiconductors including causes of the size dependence of the properties structural and electronic properties and physical characteristics of the various forms of silicon. It presents theoretical and experimental research results as well as examples of porous silicon and quantum dots. The second part discusses the synthesis of nanosilicon modification of the surface of nanoparticles and properties of the resulting particles. The authors give special attention to the photoluminescence of silicon nanoparticles. The third part describes methods used for studying and controlling the structure and properties of nanocrystalline silicon. These methods include standard ones such as electron microscopy, spectroscopy and diffraction as well as novel techniques such as femtosecond spectroscopy, ultrafast electron nanocrystallography and dynamic transmission electron microscopy. The fourth part details some of the practical applications of nanocrystalline silicon including the use of nanoparticles as additives absorbers of UV radiation in sunscreens. Incorporating much of the authors own extensive research results this book provides a systematic account of the scientific problems of nanosilicon and its potential practical applications. It will help readers understand current and emerging applications and research methods of this unique material.

*Ultrafast Structural Dynamics of Free Molecules and Condensed Matter* Anatoly A. Ischenko, Gennady V. Fetisov, Sergey A. Aseyev, 2025-12-03 It is the dream of every natural scientist to directly observe the motion of atoms and molecules in real time as they interact. The natural sciences by definition involve structural dynamics and the observation of molecules interconverting from one structure to another or other structures which is after all the very essence of science. Each area of the natural sciences has unique intellectual goals however they are all united by the thought experiment in which we try to understand how molecules interconvert between different structures by passing through a reaction barrier a transition state. This concept of a moment an ultra short time interval in the natural sciences forces us to think about the relative positions of the atoms that define the barrier to the process of their interaction. It is the control of the barrier height that allows one of many possible atomic rearrangements to occur since it occurs faster than competing processes. That is the process of molecular transformation during interaction is inherently a race against time. Manipulating the barrier height gives effective exponential control over the yield of the reaction product. The problem of visualizing transition state structures is akin to finding a way from one valley to another in a very rugged mountainous area during an earthquake where the mountains and the landscape change as you move across the terrain suddenly a crack appears and the shaking takes you to a more stable valley. Without a detailed understanding of how fluctuations in this analogy shaking affect the potential energy landscape it

would be difficult to guess where and when the crack will form or the path to the next valley At its most fundamental chemistry is the study of structural dynamics discussed both for synthetic purposes and for physical methods with the explicit goal of controlling the transformation of matter from one form property to another We now have tools to observe chemical reactions at the atomic level This monograph presents a picture of the development and evolution of methods for detecting ultrafast structural dynamics processes It describes the theoretical foundations and principles of the relevant experimental techniques as well as prospects for their improvement for application in the latest existing and developing technologies The book presents the achievements of ultrafast methods of spectroscopy electron diffraction X ray diffraction and electron microscopy for diagnostics of the structural dynamics of matter in states far from equilibrium and extreme states of matter In general the information obtained is of particular value for understanding the relationship between the elements of the structure dynamics function triad In the future this will ensure control over the functional capabilities of various materials far from equilibrium and the creation of new atomic and molecular technologies The monograph is recommended for a wide range of readers interested in the problems of the structure of matter ultrafast structural dynamics including the study of the structure and dynamics of nanomaterials scientists graduate students and students specializing in this interesting and rapidly developing area of modern natural science which is now called ultrafast science Ultrafast transmission electron microscopy uncover structure function relationships Ultra short photoelectron pulses opened up the studying of structural dynamics One electron femtosecond pulses prevents damage of biological objects Ultrafast electron microscopy uncover simultaneous real space and diffraction imaging Ultrafast diffraction and tomography holds complete information of the quantum state

**Nanoparticles in the Management of Atherosclerosis** Sourabh Mehta, 2025-01-29 The book's primary objective is to introduce the pathology and physiology atherosclerosis in brief and its diagnosis and treatment Atherosclerosis is an inflammatory disease of the arterial wall An advanced understanding of atherosclerosis shows that it leads to myocardial infarction and other cardiovascular diseases taking 17 million people every year worldwide The literature suggests that atherosclerosis is an ancient disease and is still a long standing health problem globally Hence early diagnosis and treatment of atherosclerosis are crucial to solving long standing health issues This book provides a systemic summary of recent literature focusing on disease pathology advancement in diagnosis and therapies Recently nanoparticles performing dual roles as diagnostic and therapeutic agents have been keenly interested However the nanoparticle has yet to reach the clinic Understanding the role of biomaterials in formulations and existing strategies is critical when developing novel formulations and working on translation to clinical settings The book provides a systematic biomaterial based summary of the literature methods used to formulate nanoparticles and their scale up potential Another key objective of the book is to motivate the reader to conduct research on theranostic nanoparticles to treat atherosclerosis and put us one step closer to solving a long standing health problem atherosclerosis The auto summaries have been generated by a recursive clustering algorithm via the

Dimensions Auto summarizer by Digital Science handled by Subject Matter Experts and the external editor The editor of this book selected which SN content should be auto summarized and decided its order of appearance Please be aware that the auto summaries consist of original sentences but are not representative of its original paper since we do not show the full length of the publication Please note that only published SN content is represented here and that machine generated books are still at an experimental stage

**Solid State Composites and Hybrid Systems** Rada Savkina,Larysa

Khomenkova,2018-09-03 Solid state composites and hybrid systems offer multifunctional applications in various fields of human life demonstrating solutions to the key problems of the environment human health biology medicine electronics energy harvesting and storage Exploring this innovative field of research this book details the wide range of materials techniques and approaches utilised in composite and hybrid structures in recent years It will be of interest not only for experienced researchers but also for postgraduate students and young researchers entering the fields of nanoscience material sciences and bioengineering Features Contains the latest research developments in the materials techniques patents and approaches in the field Includes both fundamental aspects and applied research Edited by two highly experienced researchers

**Advances in Imaging and Electron Physics** ,2014-04-14 Advances in Imaging Electron Physics merges two long running serials Advances in Electronics Electron Physics and Advances in Optical Electron Microscopy The series features extended articles on the physics of electron devices especially semiconductor devices particle optics at high and low energies microlithography image science and digital image processing electromagnetic wave propagation electron microscopy and the computing methods used in all these domains Contributions from leading authorities Informs and updates on all the latest developments in the field

**Silicon and Nano-silicon in Environmental Stress Management and Crop Quality Improvement** Hassan Etesami,Abdullah H. Al Saeedi,Hassan El-Ramady,Masayuki Fujita,Mohammad Pessarakli,Mohammad Anwar Hossain,2022-04-06 Silicon and Nano silicon in Environmental Stress Management and Crop Quality Improvement Progress and Prospects provides a comprehensive overview of the latest understanding of the physiological biochemical and molecular basis of silicon and nano silicon mediated environmental stress tolerance and crop quality improvements in plants The book not only covers silicon induced biotic and abiotic stress tolerance in crops but is also the first to include nano silicon mediated approaches to environmental stress tolerance in crops As nanotechnology has emerged as a prominent tool for enhancing agricultural productivity and with the production and applications of nanoparticles NPs greatly increasing in many industries this book is a welcomed resource Enables the development of strategies to enhance crop productivity and better utilize natural resources to ensure future food security Focuses on silicon and nano silicon mediated environmental stress tolerance Addresses the challenges of both biotic and abiotic stresses

**Recent Innovations in Sciences and Humanities** M. Priya,V. Anandan,2025-03-14 The Conference covered a wide range of themes in various disciplines In the field of English the conference focused on digital tools in

teaching and learning the use of AI in language teaching and learning literature in English language teaching teacher training and professional development as well as linguistic competence in English language teachers For those interested in mathematics the conference explored topics such as computational methods for linear and non linear optimization mathematical models for computer science numerical analysis boundary value problems real and complex analysis probability and statistics fluid dynamics sequence spaces mathematics education applied mathematics differential equations and game theory In the field of physics the conference delved into materials science and engineering functional materials computational materials science nanomaterials and nanotechnology structural materials photonic materials engineering biomaterials biomechanics and biosensors Lastly in the field of chemistry the conference discussed materials chemistry composite coating and ceramic materials soft matter and nanoscale materials energy systems and materials functional thin film materials nanostructures and nanofilms polymers and biopolymers as well as surface science and engineering

*Dissertation Abstracts International* ,2001    [Impact of Soil Contaminants on Plant Physiology and Crop Productivity](#)  
Wajid Zaman ,Jean Wan Hong Yong,2025-10-13 Environmental stresses are now more severe due to climatic changes Globally numerous abiotic stresses affect soil and plants hindering plant quality and productivity To enhance plant yield and quality it is crucial to understand how changes in the soil s physical and chemical properties impact plant production Plants have evolved mechanisms to cope with environmental stresses within specific limits Analyzing soil properties observing plant responses and considering various physicochemical factors are essential for understanding these stress tolerance mechanisms Heavy metals microplastic pollution pesticides pharmaceuticals and other organic and inorganic contaminants have caused significant alterations in agricultural soil Soil is a non renewable natural resource that must be managed carefully to achieve sustainable agricultural production However agricultural activities contribute to increasing soil contamination levels which are often harmful to soil health Contamination from these stressors has resulted in adverse changes in soil profiles metabolomics profiling of crops and can also affect the physiological activities of crops The soil environment has deteriorated due to the cumulative inhibitory impacts of these factors damaging agricultural productivity and ecosystem health    [Directory of Graduate Research](#) American Chemical Society. Committee on Professional Training,2005 Faculties publications and doctoral theses in departments or divisions of chemistry chemical engineering biochemistry and pharmaceutical and or medicinal chemistry at universities in the United States and Canada    **The British National Bibliography** Arthur James Wells,2002    [Investigations Into Size and Surface Control of Silicon Nanocrystals for Improved Optical Properties](#) ,2021 The discovery of visible photoluminescence PL from nanocrystalline porous silicon in 1990 led to extensive research into the mechanisms of the emergent properties and optimization of these properties for use in applications The widespread use of silicon nanoparticles Si NPs in commercial applications is currently limited by three main factors 1 poor radiative recombination efficiency of the interband transition 2 instability of the

interband photoluminescence and 3 a lack of scalable methods for producing Si NPs that are both highly crystalline and size monodisperse To address these limitations this dissertation correlates changes in the photoluminescence properties of hydrogen passivated silicon nanoparticles H Si NPs with changes in the surface structure as well as develops new synthesis methodology to produce larger more crystalline Si NPs Fundamentals and Applications of Nano Silicon in Plasmonics and Fullerines Munir H. Nayfeh, 2018-06-29 Fundamentals and Applications of Nano Silicon in Plasmonics and Fullerines Current and Future Trends addresses current and future trends in the application and commercialization of nanosilicon The book presents current innovative and prospective applications and products based on nanosilicon and their binary system in the fields of energy harvesting and storage lighting solar cells and nano capacitor and fuel cell devices and nanoLEDs electronics nanotransistors and nanomemory quantum computing photodetectors for space applications biomedicine substance detection plasmonic treatment of disease skin and hair care implantable glucose sensor capsules for drug delivery and underground water and oil exploration and art glass and pottery Moreover the book includes material on the use of advanced laser and proximal probes for imaging and manipulation of nanoparticles and atoms In addition coverage is given to carbon and how it contrasts and integrates with silicon with additional related applications This is a valuable resource to all those seeking to learn more about the commercialization of nanosilicon and to researchers wanting to learn more about emerging nanosilicon applications Features a variety of designs and operation of nano devices helping engineers to make the best use of nanosilicon Contains underlying principles of how nanomaterials work and the variety of applications they provide giving those new to nanosilicon a fundamental understanding Assesses the viability of various nanosilicon devices for mass production and commercialization thereby providing an important source of information for engineers Silicon

Nanocrystals Lorenzo Pavesi, Rasit Turan, 2010-02-02 This unique collection of knowledge represents a comprehensive treatment of the fundamental and practical consequences of size reduction in silicon crystals This clearly structured reference introduces readers to the optical electrical and thermal properties of silicon nanocrystals that arise from their greatly reduced dimensions It covers their synthesis and characterization from both chemical and physical viewpoints including ion implantation colloidal synthesis and vapor deposition methods A major part of the text is devoted to applications in microelectronics as well as photonics and nanobiotechnology making this of great interest to the high tech industry Silicon Nanowires, Carbon Nanotubes, and Magnetic Nanocrystals Doh Chang Lee, 2007 Central to the practical use of nanoscale materials is the controlled growth in technologically meaningful quantities Many of the proposed applications of the nanomaterials potentially require inexpensive production of the building blocks Solution based synthetic approach offers controllability high throughput and scalability which make the process attractive for the potential scale up Growth kinetics could be readily influenced by chemical interactions between the precursor and the solvent In order to fully utilize its benefits it is therefore pivotal to understand the decomposition chemistry of the precursors used in the reactions

Supercritical fluids were used as solvent in which high temperature reactions could take place Silicon nanowires with diameters of 20 30 nm was synthesized in supercritical fluids with metal nanocrystals as seeds for the nanowire growth To unravel the effect of silicon precursors several silicon precursors were reacted and the resulting products were investigated The scalability of the system is discussed based on the experimental data The nanowires were characterized with various characterization tools including high resolution transmission electron microscopy and electron energy loss spectroscopy The crystallographic signatures were analyzed through the transmission electron microscopic study and fundamental electrical and optical properties were probed by electron energy loss spectroscopy Carbon nanotubes were prepared by reacting carbon containing chemicals in supercritical fluids with organometallic compounds that form metal seed particles in situ A batch reaction in which the temperature control was relatively poor yielded a mixture of multiwall nanotubes and amorphous carbon nanofilaments with a low selectivity of nanotubes in the product When reaction parameters were translated into a continuous flow through reaction nanotube selectivity as well as the throughput of the total product significantly improved Magnetic properties of various metal nanocrystals were also studied Colloidal synthesis enables the growth of FePt and MnPt<sub>3</sub> nanocrystals with size uniformity The as synthesized nanocrystals however had compositionally disordered soft magnetic phases To obtain hard magnetic layered phase the nanocrystals must be annealed at high temperatures which led to sintering of the inorganic cores To prevent sintering the nanocrystals were encapsulated with silica layer prior to annealing Interparticle magnetic interactions were also explored using particles with varying silica thickness

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