

Nonlinear-Optical Properties of Porous Silicon Nanostructures

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In the present review, we consider in detail nonlinear-optical properties of porous silicon. The nonlinear-optical properties of porous silicon are discussed in close connection with its linear optical properties. Such coherent nonlinear-optical processes as the second- and third harmonic generation are considered, with special interest to the variations of the nonlinear susceptibility tensor, phase matching in the birefringent porous silicon, and effect of the photonic crystals. Incoherent nonlinear-optical processes as nonlinear refraction, optical bleaching, and two-photon absorption are also reviewed, the different mechanisms responsible for them are discussed.

Keywords: Porous Silicon, Nanostructures, Nonlinear Optics, Harmonic Generation, Light Self-Action.

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1. INTRODUCTION

Nonlinear-optical effects are significant under interaction of the matter and intense laser radiation. The feature of the nonlinear-optical processes is nonlinear dependence of the matter polarization of the electric field. For more than

fifty years the nonlinear optics have become a sufficient part of optics and electrodynamics; at the present time it is one of the bases of the modern photonics. It is nonlinear-optical effects that are responsible for wave mixing and frequency conversion, ultrashort laser-pulse generation and optical switching.

Nonlinear response of medium to powerful optical wave results in generation of nonlinear polarization wave at frequency ω in the medium. For the cases, when the nonlinear polarization is generated by two or three waves (including degenerative cases), amplitudes of the nonlinear polarization wave P_{NL} are connected with the amplitudes of interacting waves E by equations:

$$P_{NL,i}(\omega) = \chi_{ijk}^{(2)}(\omega; \omega_1, \omega_2) E_{1,j} E_{2,k}$$

$$P_{NL,i}(\omega) = \chi_{ijkl}^{(3)}(\omega; \omega_1, \omega_2, \omega_3) E_{1,j} E_{2,k} E_{3,l}$$

correspondingly, where $\chi^{(2)}$ and $\chi^{(3)}$ are nonlinear susceptibilities of the second and third orders, correspondingly, $\omega_1, \omega_2, \omega_3$ are frequencies of interacting waves, with ω being their combination, subscripts i, j, k, l denote Cartesian coordinates.

Porous silicon (por-Si)—a nanocomposite medium consisting of nanometer-size silicon crystals separated by the pores of similar size—now attracts a great interest for the nonlinear optics. On the one hand, nowadays, silicon is becoming an important material for photonics that is why nonlinear-optical properties of silicon-based devices are of great importance.^{1–2} On the other hand, porous silicon is a good model object for the study of the nanocomposite nonlinear-optical properties, which could significantly differ from ones of their constituents.³ At last, some

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Structural And Optical Properties Of Porous Silicon Nanostructures

Claudia Maria Simonescu



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Structural and Optical Properties of Porous Silicon Nanostructures G Amato, C. Delerue, H J VonBardeleben, 1998-02-25

This volume provides a comprehensive review of the experimental and theoretical aspects of the optical and transport properties of nanoporous silicon their relation to the microscopic structure of nanocrystals and the application of porous silicon in optical devices As porous silicon is an ideal substance for the modelling of optical processes in nanocrystalline materials this volume also is an excellent reference source on the more general subject of the structural and optical properties of nanocrystalline semiconductors

Structural And Optical Properties Of Porous Silicon Nanostructures
G. Amato, **Porous Silicon: From Formation to Application: Formation and Properties, Volume One** Ghenadii

Korotcenkov, 2016-04-21 Porous silicon is rapidly attracting increasing interest in various fields including optoelectronics microelectronics photonics medicine chemistry biosensing and energy Porous Silicon Formation and Properties fills a gap in the literature of the field today providing a thorough introduction to current knowledge of the formation process in

Nanostructured Films and Coatings Gan-Moog Chow, Ilya A. Ovid'ko, Thomas Tsakalakos, 2012-12-06 Nanostructured films and coatings possess unique properties due to both size and interface effects They find many applications in areas such as electronics catalysis protection data storage optics and sensors The focus of the present book is on synthesis and processing advanced characterization techniques properties including mechanical chemical electronic thermal catalytic and magnetic modelling of interlayer and intralayer interfaces and applications

Optical Properties of Low Dimensional Silicon Structures B. Bensahel, Leigh T. Canham, Stephano Ossicini, 2012-12-06 The workshop on Optical Properties of Low Dimensional Silicon sL Structures was held in Meylan France on March 1 yd 1993 The workshop took place inside the facilities of France Telecom CNET Around 45 leading scientists working on this rapidly moving field were in attendance Principal support was provided by the Advanced Research Workshop Program of the North Atlantic Treaty Organisation NATO French Delegation a l Armement and CNET gave also a small financial grant the organisational part being undertaken by the SEE and CNET There is currently intense research activity worldwide devoted to the optical properties of low dimensional silicon structures This follow the recent discovery of efficient visible photoluminescence PL from highly porous silicon This workshop was intended to bring together all the leading European scientists and laboratories in order to reveal the state of the art and to open new research fields on this subject A large number of invited talks took place 12 together with regular contribution 20 The speakers were asked to leave nearly 1 3 of the time to the discussion with the audience and that promoted both formal and informal discussions between the participants

Handbook of Gas Sensor Materials
Ghenadii Korotcenkov, 2013-11-08 The two volumes of Handbook of Gas Sensor Materials provide a detailed and comprehensive account of materials for gas sensors including the properties and relative advantages of various materials Since these sensors can be applied for the automation of myriad industrial processes as well as for everyday monitoring of

such activities as public safety engine performance medical therapeutics and in many other situations this handbook is of great value Gas sensor designers will find a treasure trove of material in these two books Nanocrystals and Nanostructures Claudia Maria Simonescu,2018-10-17 Nanocrystals and nanostructures attract a special attention in the recent years due to their various properties and a wide range of applications such as in electrical optical optoelectronic catalytic medicine chemo and biosensing and environmental protection fields Although extensive research has been done in the field of nanocrystals it is considered one growing research field The main goal of this book is to present the current research activities in the field of nanocrystals and nanostructures covering issues regarding new synthesis methods self assembly strategies characterization techniques properties and applications Interesting reports regarding biomimetic modeling of the biomineralization processes and theoretical models to describe mechanisms of deformation twinning in nanocrystalline and ultrafine grained materials have been presented By structuring approaching and content the work may be useful for specialist in the field of nano materials science PhD students students and all those interested in this topic of high relevance **Light Emitting Silicon for Microphotonics** Stefano Ossicini,Lorenzo Pavesi,Francesco Priolo,2003-11-12 A fascinating insight into the state of the art in silicon microphotonics and on what we can expect in the near future The book presents an overview of the current understanding of getting light from silicon It concentrates mainly on low dimensional silicon structures like quantum dots wires and wells but covers also alternative approaches like porous silicon and the doping of silicon with rare earths The emphasis is on the experimental and theoretical achievements concerning the optoelectronic properties of confined silicon structures obtained during recent years Silicon based photonic crystals are in particular considered An in depth discussion of the route towards a silicon laser is presented **Advances in Heat Transfer** James P. Hartnett,2003-10-09 Advances in Heat Transfer presents review articles on topics of current interest Each contribution starts from widely understood principles and brings the reader up to the forefront of the topic being addressed The favorable response by the international scientific and engineering community to the 37 volumes published to date is an indication of the success of our authors in fulfilling this purpose This is recommended reading for all mechanical engineers and researchers Provides an overview of review articles on topics of current interest Bridges the gap between academic researchers and practitioners in industry A long running and prestigious series Semiconductors and Electronic Materials Andreas Mandelis,Peter Hess,2000 Semiconductors and electronic materials have benefitted from photoacoustic and photothermal techniques since the late 1970s This volume the fourth in a series on photothermal and photoacoustic science and technology PPST presents a comprehensive review of the diverse progress made in PPST of semiconductors and electronic materials during the 1990s The 10 chapters review leading research activities in several subfields of PPST These include applications of novel analytical and or experimental techniques to traditional semiconductor materials and devices as well as applications of conventional techniques to novel materials and devices As with other volumes

in the series this text is useful as a reference for practising scientists and engineers and as a supplement to upper level graduate courses in various areas of PPST and its subfields

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lycomedes he is led instead to the princess deidameia

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